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USSR Report

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CONTENTS

ORGANIZATION, PLANNING AND COORDINATION

INSTRUCTIONS ON ORGANIZATION OF WORK ON DEVELOPING NEW EQUIPMENT

Moscow EKONOMICHESKAYA GAZETA in Russian No 41, Oct 84 p 14

[Article: "The Cost Accounting System of the Organization of Work on the Development of New Equipment"]

> [Text] The State Committee for Science and Technology, the USSR State Planning Committee, the USSR State Committee for Construction Affairs, the USSR State Committee for Material and Technical Supply, the USSR State Committee for Labor and Social Problems, the USSR Ministry of Finance, the USSR State Bank and the All-Union Bank for Financing Capital Investments in consultation with the All-Union Central Council of Trade Unions have approved "The Procedural Instructions on the Changeover of Associations, Enterprises and Organizations of Construction, Transportation, Communications, Geology, Agriculture and Material and Technical Supply to the Cost Accounting System of the Organization of Work on the Development, Assimilation and Introduction of New Equipment (No 40-7/182 of 29 June 1984), the text of which at the request of readers is published below.

1. In conformity with Decree No 814 of the CPSU Central Committee and the USSR Council of Ministers of 18 August 1983, "On Measures on the Acceleration of Scientific and Technical Progress in the National Economy," it is envisaged to carry out in 1985-1987 the changeover of associations, enterprises and organizations of construction, transportation, communications, geology, agriculture and material and technical supply to the cost accounting system of the organization of work on the development, assimilation and introduction of new equipment on the basis of supply orders (contracts).

The end results, including the economic impact for the national economy, the performers and the dates of the fulfillment of the work at all stages--from scientific research to the introduction of the results in production, as well as the necessary material resources, the amounts and sources of financing and of the material stimulation of the workers are specified in the supply orders (contracts).

2. The changeover of associations (enterprises) and organizations to the cost accounting system of the organization of work on the development, assimilation and introduction of new equipment is carried out by the ministry or department on the basis of these procedural instructions with allowance made for the specific peculiarities of the sector.

3. When performing the preliminary work on the changeover of associations (enterprises) and organizations to the cost accounting system of the organization of work on the development, assimilation and introduction of new equipment on the basis of supply orders (contracts) the ministry (department) is obliged:

to analyze the scientific research activity of subordinate organizations and enterprises, to evaluate the results of scientific research, experimental design work and work on the assimilation of new equipment during the preceding period (the 5-year period, a number of years), to analyze the results of the introduction in the national economy of the new equipment which was developed in the sector, to determine the economic impact from its use, to use the positive experience of the sectors of industry, which are operating under the conditions of the cost accounting system, to organize the increase of the skills of personnel at all levels of management;

to approve organizational and technical measures, which are aimed at the obtaining of a greater economic impact in the national economy from the new equipment being produced by the sector, the increase of the quality of the output being produced, the shortening of the standard (planned) time of the development and assimilation of new equipment, the introduction of the scientific organization of labor and of developments, which decrease significantly the materials-output ratio and the labor intensiveness of production, first of all in jobs with difficult and harmful working conditions, the increase of the role of bonus systems for the development and assimilation of new equipment;

to elaborate measures on the improvement of the work of subordinate associations (enterprises) and organizations, the improvement of cost accounting and the organizational structures of management, the strengthening of the units which deal with questions of science and technology.

4. The amounts of the expenditures on scientific research, experimental design, technological planning and technological operations are specified by the USSR State Committee for Science and Technology, the USSR State Planning Committee, the USSR Ministry of Finance (on construction questions jointly with the USSR State Committee for Construction Affairs) and are established in the plans of ministries (departments) as a percent of the indicators which reflect the volume of production (operations) in comparable measurements.

5. A unified fund for the development of science and technology is established in the ministry (department) for the financing of scientific research, experimental design, technological planning and technological operations and the recovery of the expenditures, which are connected with the development and assimilation of new types of products and technological processes, with the introduction of the scientific organization of labor, as

well as the additional expenditures on the improvement of product quality and the increased expenditures during the first years of the production of a new product (which are financed at present from the assets of the state budget, the profit, deductions from the production cost of the product, construction and installation work and other internal sources, which are envisaged accordingly in the plans of the production cost of the product, construction and installation work, transportation, in the plans of operating expenses and in the plans on the distribution costs of trade, supply, marketing and procurement organizations and other plans).

The unified fund for the development of science and technology is formed by means of deductions from the planned profit of the associations (enterprises) and organizations, which are being changed over to the cost accounting system of the organization of work on new equipment, in accordance with the standards which have been established in the five-year plan (with a breakdown by years) as a percentage of the indicators which reflect the volume of production (operations) in comparable measurements.

When specifying the standards of the deductions for the unified fund for the development of science and technology for the period being planned it is necessary to proceed from the amount of the internal expenditures on the performance of scientific research, experimental design, technological planning and technological operations and measures, which are connected with the development and assimilation of new equipment during the period which precedes the period being planned.

For the financing of especially important scientific research operations, which require significant expenditures, along with the assets of the unified fund for the development of science and technology, in accordance with a decision of the USSR State Committee for Science and Technology and the USSR Ministry of Finance (on construction questions jointly with the USSR State Committee for Construction Affairs) assets of the state budget can also be used.

The formation and use of the assets of this fund are carried out in conformity with the Methods Instructions No 40-7/197 on the Procedure of the Formation and Use of the Unified Fund for the Development of Science and Technology, which were approved by the USSR State Committee for Science and Technology, the USSR State Planning Committee, the USSR Ministry of Finance and the USSR State Committee for Prices on 11 September 1979. The peculiarities of their use in construction, transportation, communications, geology, agriculture and material and technical supply are established by the appropriate ministry (department) in consultation with the USSR State Committee for Science and Technology, the USSR State Planning Committee, the USSR Ministry of Finance and the USSR State Committee for Prices (on construction questions jointly with the USSR State Committee for Construction Affairs).

6. For the purpose of the stimulation of scientific and technical progress and the increase of the efficiency of work at the enterprises, which are being changed over to the cost accounting system of the organization of work, a material incentive fund, a fund for sociocultural measures and housing

construction and a fund for the development of the organization are established.

The formation and use of the assets of the economic stimulation funds are carried out in conformity with Statute No 40-7/77 on the Procedure of the Formation and Use of Economic Stimulation Funds at Scientific Research, Design, Planning and Design and Technological Organizations, Production Associations and Enterprises, Which Have Been Changed Over to the Cost Accounting System of the Organization of Work on the Development, Assimilation and Introduction of New Equipment on the Basis of Supply Orders (Contracts), which was approved by the USSR State Committee for Science and Technology, the USSR State Planning Committee, the USSR State Committee for Labor and Social Problems, the USSR Ministry of Finance and the All-Union Central Council of Trade Unions on 10 April 1980.

In the sectors, in which there have been set up scientific production associations, for which the peculiarities of the application of the Statute on the Scientific Production Association, which was approved by Decree No 1062 of the USSR Council of Ministers of 30 December 1975, have been specified in accordance with established procedure, the economic stimulation funds are formed and used in conformity with Statute No 16/11 on the Procedure of the Formation and Use of the Economic Stimulation Funds of Scientific Production Associations, which was approved by the USSR State Committee for Science and Technology, the USSR State Committee for Labor and Social Problems, the USSR State Planning Committee, the USSR Ministry of Finance and the All-Union Central Council of Trade Unions on 19 July 1976.

In case of necessity the corresponding ministries (departments) elaborate and approve in consultation with the USSR State Committee for Science and Technology, the USSR State Planning Committee, the USSR State Committee for Labor and Social Problems, the USSR Ministry of Finance and the All-Union Central Council of Trade Unions (on construction questions jointly with the USSR State Committee for Construction Affairs) the peculiarities of the application of the statutes on the procedure of the formation and use of economic stimulation funds.

7. The payment of bonuses to the workers of the associations (enterprises) and organizations, which are being changed over to the cost accounting system of the organization of work on the development, assimilation and introduction of new equipment, is carried out in conformity with Model Statute No 31/5-2 on the Payment of Bonuses to Workers of Scientific Research, Design, Planning and Design and Technological Organizations, Production Associations and Enterprises, Which Are Being Changed Over to the New System of the Planning, Financing and Economic Stimulation of Work on New Equipment, which was approved by the USSR State Committee for Labor and Social Problems and the All-Union Central Council of Trade Unions on 30 January 1978.

The reward for the overall results of work in accordance with the totals for the year is paid to the workers of associations (enterprises) and organizations in conformity with the Recommendations on the Procedure and Conditions of the Payment to the Workers of Enterprises and Organizations of the National Economy of the Reward for the Overall Results of Work in

Accordance With the Totals for the Year, which were approved by Decree No 177/P-13 of the USSR State Committee for Labor and Social Problems and the All-Union Central Council of Trade Unions on 10 August 1983.

8. The ministries and departments should in consultation with the USSR State Committee for Science and Technology, the USSR Ministry of Finance, the USSR State Bank and the All-Union Bank for Financing Capital Investments carry out during the 12th Five-Year Plan the changeover of organizations to the system of settlements for work, which has been completely finished and accepted by the client, instead of payment for it by stages. The changeover is carried out in conformity with Instructions No 40-7/215 on the Changeover of Sectorial Scientific Research, Planning and Design, Technological and Planning and Surveying Organizations to the System of the Payment for Work, Which Has Been Completely Finished and Accepted by the Client, which were approved by the USSR State Committee for Science and Technology, the USSR State Planning Committee, the USSR State Committee for Construction Affairs, the USSR State Committee for Labor and Social Problems and the USSR Ministry of Finance in consultation with the All-Union Central Council of Trade Unions, the USSR State Bank and the All-Union Bank for Financing Capital Investments on 12 October 1979.

9. The USSR State Bank and the All-Union Bank for Financing Capital Investments grant credit:

to ministries and departments for operations, which are financed by means of the assets of the unified fund for the development of science and technology, in case of the noncoincidence during the year of the payment of assets to this fund and the amounts of the expenditures, which are made from this fund;

to scientific production and production associations (enterprises);

for the payment for operations, which are financed by means of the assets of the unified fund for the development of science and technology, if the indicated operations are performed in a shorter time than envisaged by the plan;

for the implementation of highly effective measures on the development of science and technology in excess of the limit of state capital investments with the repayment of the credit and the interest for the credit within 2 years from the day of its issuing by means of the assets of the unified fund for the development of science and technology. The indicated credit is granted on the guarantee of the ministry (department) or the all-union (republic) association.

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ORGANIZATION, PLANNING AND COORDINATION

PLANNING OF SCIENTIFIC, TECHNICAL DEVELOPMENT OF ENTERPRISES

Moscow IZVESTIYA AKADEMII NAUK SSSR; SERIYA EKONOMICHESKAYA in Russian No 6, Nov-Dec 84 pp 56-66

[Article by L. E. Akhvlediani, Ya. N. Dranev and A. I. Seits: "The Improvement of the Planning of the Scientific and Development of Enterprises"; passages rendered in all capital letters printed in italics in source]

[Text] A number of basic economic problems of the management of the scientific and technical development of enterprises are examined, a critical analysis of the theory and practice of the management of scientific and technical progress in this unit of the national economy is made, the basic directions of the improvement of the planning and management of scientific and technical activity are specified. A new approach to the coordination of the plans of production and scientific and technical progress, which makes it possible to increase substantially the soundness and balance of the planning of production, scientific and technical activity at the enterprise, is proposed on the basis of the enlargement of the set of indicators, which are used for the evaluation of measures of scientific and technical progress, and the goals of the planning of scientific and technical development.

Scientific and technical progress is a decisive factor of the development of social production. Its dominant role in the development of the productive forces of society appeared back in the 19th century. K. Marx wrote that "as large-scale industry develops, the creation of real wealth... will be governed not by the expenditures of labor in the sphere of production, but first of all will depend... on the overall level of science and on the progress of technology, or on the application of this science to production" [1].

At present the problem of the acceleration of scientific and technical progress has become even more urgent. This is explained by many factors, among which the decrease of the role of extensive factors in the development of the economy is one of the most important. Therefore the decisions of the 25th and 26th party congresses and the subsequent CPSU Central Committee plenums aim scientists and economic managers at the assurance of the all-round

intensification and the increase of the efficiency of social production on the basis of the latest achievements of science and technology. Thus, in the decree of the CPSU Central Committee and the USSR Council of Ministers "On Measures on the Acceleration of Scientific and Technical Progress in the National Economy" [2] it is indicated that for the purposes of increasing the responsibility for the implementation of measures of scientific and technical development "the fulfillment of the plans and assignments on the development of science and technology are included among the most important indicators, in accordance with which first of all the evaluation of the results of the economic activity of associations (enterprises) is made."

The improvement of the management of scientific and technical development, which finds expression in the strengthening of the comprehensive goal-oriented effect on the entire set of contacts and relations, which arise in the process of scientific and technical activity, is an important factor of the acceleration of the pace of scientific and technical progress. The questions, which are connected with the accumulation of scientific knowledge, the use of the results of scientific research work in the sectors of the national economy, the development and assimilation of new equipment, technology and materials and their extensive introduction in industry, the improvement of the systems of the organization of production activity, the breakdown of resources by versions and directions of the development of production and so on, apply to it.

A necessary condition of the effective management of scientific and technical development is the complete coverage of all the units of the national economy. As the analysis shows, at present the basic efforts of researchers are focused on the macrolevel of the management of scientific and technical progress, while in the local units of the national economy--associations, enterprises--where in the end the implementation of its results occurs, this condition does not find adequate reflection. At the same time the problem of improving the management of the development of science and technology at the level of individual enterprises is becoming more and more urgent in connection with the broadening of the independence and rights of enterprises in the choice of the directions of the intensification of production, since under the conditions of the limitedness of resources and the exhaustion of the progressive role of extensive factors a scientifically sound policy of technical development to a decisive extent determines the results of the production operations of the enterprise.

The economic and technical problems of scientific and technical progress at the enterprise presume the accomplishment, on the one hand, of the goals of the development of production, which appear in the increase of the output of new, highly efficient products and the improvement of their quality, and, on the other, of the goals of scientific and technical development, which have as their result the steady improvement of the means of production. In other words, scientific and technical progress at the enterprise is being developed in the following directions:

the increase of the technical level of the output being produced;

the introduction of new processing methods and the improvement of the prevailing ones;

the complete mechanization and automation of production;

the use of new advanced types of equipment and the replacement of obsolete equipment;

the assurance of the most efficient nature of the organization of production activity;

the improvement of the production structure of the enterprise, the development of methods of the forecasting, planning and management of production activity;

the conducting of scientific research and experimental design work;

the training of specialists and the increase of the skills of the personnel of the enterprise;

the improvement of the indicators of the technical and economic level of production;

nature conservation and the efficient use of natural resources.

For the most part these directions of scientific and technical development find their reflection in the third section of the technical, industrial and financial plan of the enterprise--the plan of technical development and the organization of production. However, neither the composition of the sections of the plan of technical development and the organization of production and the large number of forms, in accordance with which it is drafted, nor the set of indicators, which are used for the evaluation of the effectiveness of measures of scientific and technical progress, nor the interconnection of the procedures of the planning of scientific and technical progress with the formulation of other sections of the production plans fully conform to the tasks of scientific and technical progress at the enterprise.

The greatest problems are connected with the inadequate coordination of the plan of scientific and technical development with the other sections of the technical, industrial and financial plan. According to the Standard Method [3], the effectiveness of measures of scientific and technical development is characterized by three indicators: by the decrease of the production cost and the labor intensiveness of the production of the product and by the annual economic impact. The first two indicators are established for the enterprise for the current year, and, it would seem, the plan of scientific and technical development (NTR)[1] reflects quite thoroughly the needs of production. However, the indicators in question evaluate only the overall saving of living labor and current production costs without regard for what types of operations or materials, with respect to which the saving is achieved. At the same time one of the most important tasks of the plan of scientific and technical development--the assurance of the fulfillment of the plan assignments on the production and sale of products due to measures of scientific and technical development--can be accomplished only in case of the availability of

information on the saving of resources with respect to each measure and the establishment of control assignments on the elimination of the shortage of each type of resources. The evaluation of the effectiveness of measures of scientific and technical development only in accordance with the indicators, which are established by the method, leads to a situation, when the plan assignments on them are fulfilled and exceeded, but the enterprise experiences a significant shortage of some types of resources while there is an abundance of others. And therefore it is not by chance that the abundance of measures of scientific and technical progress and their great potential economic impact do not have a significant influence on the solution of the problem of a shortage, for example, of a regular labor force [4].

The lack of coordination in the formulation of the plan of scientific and technical development and the other sections of the production plan also appears in the questions of the resource support of the measures of scientific and technical development, which are proposed for implementation. First, the parallel drafting of different types of plans by different services of the enterprise is widespread in practice, which does not make it possible to accurately take into account the portion of the resources, which is necessary for the implementation of the measures of scientific and technical progress, and, consequently, to evaluate their economic impact. Second, violations in the financing of measures from special-purpose sources are frequently allowed. Third, at the majority of enterprises the need only for financial resources for the implementation of measures of scientific and technical progress is taken into account when formulating the plan of scientific and technical development. At the same time the implementation of a portion of these measures requires the production at this enterprise of nonstandard equipment, tools and accessories (the analysis made by the authors of the plans of scientific and technical development of a number of enterprises attests that the labor intensiveness of the elaboration of measures of scientific and technical progress amounts to up to 5 percent of the total available working time of the personnel of the enterprises). This leads to the imbalance of the production assignments and the production resources, which the enterprises have, which under the conditions of a shortage of resources prompts it to solve problems which are connected first of all with the output of products. The fact that approximately half of the measures of scientific and technical progress are not implemented as a result of the failure to back them with materials, the untimely production of accessories, attachments and so on, in many ways is explained by them [5].

Significant shortcomings also exist in the organization of the process of planning scientific and technical progress. At many enterprises the planning of the technical development of production is carried out not in accordance with the standard forms, here both the composition of the sections of the plan of scientific and technical development and the used technical and economic indicators are chosen relatively independently. At various enterprises the measures of scientific and technical progress are united into "the plan of the increase of production efficiency," "the plan of organizational and technical measures" and so on. The fact that in the majority of sectors there is no elaborated method of formulating the plan of scientific and technical development and, moreover, this plan is not approved by a superior organization (as, for example, the production program is), to a significant

extent is also conducive to this. The indicated circumstances have the result that at the enterprise it plays a secondary role and does not ensure the accomplishment of the tasks of the scientific and technical policy.

The strict differentiation of the directions of the effect of measures, which stems from their assignment to some one section of the plan of scientific and technical development, serves as a serious obstacle to the increase of the effectiveness of the management of scientific and technical development. Such an approach to planning by sections (and they actually are independent plans) leads to the artificial division of the measures, which have a single ultimate goal, causes definite difficulties in the distribution of the resources, which have been allocated for this plan, complicates the process of implementing its measures and eliminates the possibility of taking their combine impact into account.

It is also necessary to note the inadequate qualitative level of the composition of the measures of the plan of scientific and technical development at individual enterprises. As a rule, these are minor, ineffective measures, which are aimed at the solution of special, immediate problems which to no extent govern scientific and technical policy. According to the data of a survey of a number of machine building enterprises of the Central Urals [5], about 53 percent of all the measures included in the plan of scientific and technical development were suggested by personnel of the given enterprises. As experience shows, in the majority of cases their economic impact is low. And it is not surprising that at enterprises and associations of separate sectors the measures of scientific and technical development in 1982 ensured an increase of labor productivity and the decrease of the product cost by only 30-40 percent with respect to the directive assignment [6]. Here the experience of the leading enterprises and sectors, the materials of special seminars and exhibitions and the information on questions of scientific and technical progress are being used entirely inadequately.

The methods of selecting measures, which are being used at enterprises, also do not meet the present demands on the planning of scientific and technical development. The analysis of planning practice showed that frequently the amount of the annual economic impact serves as the only criterion of the inclusion of measures in the plan of scientific and technical development, while the indicators of the decrease of the production cost and the labor intensiveness of the production of products are estimated indicators. Such a technique of selecting measures has even found reflection in scientific and reference literature [7]. The untenability of such an approach was already noted above when examining the set of indicators which evaluate the effectiveness of measures of scientific and technical development. Moreover, the current planning of scientific and technical progress at enterprises is of a discrete nature and is poorly coordinated with its long-range tasks. Frequently the plans on the development of science and technology are drawn up so as to introduce practically all the measures by the end of the planning year. As a result of the considerable time of elaboration it is necessary to assimilate them during the last quarter of the year, which leads to overloading in the work of individual subdivisions during this period and the

obtaining of the maximum amount of saving, while for the enterprise the breakdown of the impact by periods is important.

In matters of the determination of the optimum (or efficient) set of measures of scientific and technical development and the time of their introduction a significant role belongs to the methods of mathematical economic modeling. However, in the practice of formulating the plan of scientific and technical progress multivariant calculations on the basis of models are being used insufficiently, the optimization of the decisions being made in this area is practically absent. And this is in spite of the fact that quite a number of different approaches to the modeling of the indicated processes are proposed in scientific literature [7-9].

In the formulation of mathematical economic models of the formation of the plan of scientific and technical development it is possible to distinguish several directions: 1) models which are based on the use of production functions; 2) the use of the rules of preference for the choice of measures of scientific and technical progress and the time (or sequence) of their introduction; 3) the use of linear statistical optimization models; 4) the use of dynamic nonlinear and linear optimization models; 5) multicriterional linear optimization models; 6) sets of interconnected models of the planning of scientific and technical progress and the production program.

The approaches, which have been proposed by various authors, to the modeling of the processes of the formulation of plans of scientific and technical development have common shortcomings. First, they reflect the existing system of the planning of scientific and technical progress and as a consequence use a narrow group of indicators of the evaluation of the effectiveness of measures of scientific and technical progress and their need for resources without regard for the dependence of the impact on the time of the introduction of the measures. Second, the questions of the resource support of the measures of scientific and technical progress and the questions of the elimination of the shortage of resources for the production program are examined in isolation, which is illegitimate. Third, the possibility of the specification of the production program on the basis of the chosen measures of scientific and technical progress with the subsequent adjustment of the plan of scientific and technical development for the changed assignments on the range and volume of output being produced is not envisaged.

In spite of the extensive dissemination of automated control systems of enterprises the majority of operating systems and the standard composition of the problems, which are solved within them, do not envisage a subsystem of the technical development of the enterprise. In part this is explained, as has already been noted, by the inadequate elaboration of the methods of modeling problems of this sort. The main reason, in our opinion, consists in the established attitude toward the plan of scientific and technical development as a secondary section of the technical, industrial and financial plan and in the underestimation of the importance of the problem of the scientific and technical development of the enterprise and the degree of its influence on the results of production operations.

The organization of the management of the implementation of measures of scientific and technical progress also requires much attention. The factor of the novelty of the decisions being implemented affects the stochastic nature of the formulation and introduction of measures of scientific and technical progress to a much greater extent than it affects the output of products. This leads to the need to organize the regular monitoring of the fulfillment of the plan of scientific and technical development and to shift resources in good time for the successful accomplishment of the assignments on the development of science and technology. The rare instances of difficulties, which arise in practice, in the implementation of individual measures of scientific and technical progress either are a consequence of the system, which has been established at enterprises, of the checking of the fulfillment of the plans of scientific and technical development in accordance with the certificates of the introduction of measures or are explained by the absence of a "boss"--a division or bureau of scientific and technical progress.

The noted shortcomings in the planning and management of scientific and technical progress at enterprises adversely influence the increase of the efficiency of production operations. The improvement of the organization of the planning and management of scientific and technical progress is the basic prerequisite of the increase of the efficiency of the economy under the conditions of mature socialism and the implementation of policy of the intensification of social production, which has been adopted by the party and government. The individual measures, which have been proposed in the scientific literature (see [5, 8, 10]) on this question, do not make it possible to solve these problems cardinally as a result of their isolation and autonomy. The formulation of a comprehensive set of interconnected and complementary measures is a necessary condition of the successful implementation of the program of the improvement of the mechanism of managing the scientific and technical development of enterprises.

The Increase of the Role of the Forecasting and Long-Range Planning of Scientific and Technical Progress. Since the annual plans of scientific and technical development are not capable of taking into account the main prevailing factors of scientific and technical progress for a long period, which to a significant extent ensure the increase of production efficiency and the improvement of its material base and the quality of the output being produced, it is necessary to devote the basic attention to the formation of long-term forecasts and long-range plans of the development of enterprises, which at present are not being formulated at all at many enterprises. This will make it possible to determine purposefully the technical policy of the enterprise, to change radically the established scientific and technical level of production, to evaluate comprehensively for a quite long interval of time the conditions of the implementation and the effectiveness of measures of scientific and technical progress and to provide the long-range assignments on the output of products with the necessary resources.

Owing to the significance of the lag of the impact of measures of scientific and technical progress with a long period of elaboration it is necessary to increase the horizon of planning when formulating the current plans of scientific and technical progress to at least 2 years.

The solution of these problems requires THE COMPREHENSIVENESS OF THE FORMATION OF THE PLAN OF SCIENTIFIC AND TECHNICAL PROGRESS. The comprehensive approach to the planning of scientific and technical development at the enterprise presumes, first, the linking of scientific forecasting, long-range and current planning and the coordination of these plans with the programs of the development of the corresponding sectors; second, the interconnection of the production program and the plans of capital construction, material and technical supply and financing; third, the combination of the measures of scientific and technical progress into a unified plant, which will make it possible to simplify the process of the management of scientific and technical progress at the enterprise and to make a qualitative analysis of the effect of scientific and technical processes by different directions of technical development. At scientific production associations the comprehensiveness of the planning of scientific and technical progress also signifies the need for the unified planning of science and production and the drafting of a so-called scientific production plan.

In this connection the use of the systems approach as a methodological tool of the comprehensive solution of the problems of the planning of scientific and technical development is of the greatest importance. It makes it possible to examine the problems in a broad context and to cover the questions of the formulation of the ultimate goals, the determination of the possible alternatives of their achievement and the development of the appropriate mechanism of management.

THE THOROUGH EVALUATION OF THE RESULTS OF THE INTRODUCTION OF MEASURES OF SCIENTIFIC AND TECHNICAL DEVELOPMENT AND THEIR RESOURCE BACKING is a necessary condition of the use of the systems approach to the planning of scientific and technical progress. This makes it possible to envisage the meeting of the need for resources of various kinds in the plans of capital construction, material and technical supply and financing and to estimate quantitatively the influence of each measure on the improvement of the values of the chosen technical and economic indicators and on the increase of resources. Such an approach will make it possible to establish the control values of these indicators and the required increase of resources for the plan of scientific and technical progress. But this, in turn, will contribute to the increase of the responsibility of the performers for the fulfillment of the plan of scientific and technical progress, since the direct connection of the plans of production and scientific and technical progress is accomplished by the decrease of the norms of labor expenditures and the consumption of materials, fuel and electric power.

The realization of these possibilities presumes THE USE OF A METHOD OF THE PLANNING of scientific and technical progress at enterprises. The improvement of the procedures of the formulation of the plan of scientific and technical progress should proceed in the following directions: 1) the formulation and use of a scientifically sound method of the evaluation of the results of the introduction of measures of scientific and technical progress; 2) the determination of an efficient degree of aggregation of the measures; 3) the development of algorithms of the selection of measures in the plan of scientific and technical development and the determination of the time of

their introduction (there are great opportunities here for the use of mathematical economic methods).

The fulfillment of the listed measures on the improvement of the planning and management of scientific and technical progress is possible only on the condition of THE ESTABLISHMENT AT THE ENTERPRISE OF A UNIFIED ORGAN OF THE MANAGEMENT OF SCIENTIFIC AND TECHNICAL DEVELOPMENT--a division of scientific and technical progress. The analysis of the technical, economic and organizational level of production at the enterprise; the formulation of forecasts of the development of production and of long-range, current and operational plans of scientific and technical progress; production control and the monitoring of the fulfillment of these plans and the spending of financial assets; the elaboration of a methodology of the forecasting, planning and regulation of scientific and technical operations; the supply of the subdivisions of the enterprise with scientific and technical information; the organization of efficiency and inventing work; the conducting of scientific research and experimental design work of an economic and organizational nature; the organization of the training and the increase of the skills of scientists and engineering and technical personnel of the enterprise; the improvement of the methodology of stimulating the operations on scientific and technical development; the performance of patent work; the drafting of plans on the scientific organization of labor, the improvement of the structure and the methods of the management of the production operations of the enterprise and so on should become the tasks of this division.

In other words, the division of scientific and technical progress should unite and aim the work of the previously separate subdivisions of the enterprise: the division of scientific and technical information, the division of the scientific organization of labor, the patent division and others, at the formulation and implementation of a unified scientific and technical policy. Such organization of the management of scientific and technical activity makes it possible to develop purposefully the various directions of scientific and technical progress, simplifies the processes of the management of technical development, shortens the time of the introduction of measures of scientific and technical progress and increases the soundness of the plans of scientific and technical progress and, consequently, the percentage of the feasibility of the measures.

The limited size of the article does not make it possible to cover fully the conditions and means of the realization of all the outlined directions of the improvement of the management of the scientific and technical development of enterprises. Therefore among the set of problems in this work one of the most important problems of the increase of the effectiveness of the management of scientific and technical progress has been chosen--the coordination of the current plan of scientific and technical development and the production program. The urgency of the examination and solution of this problem is explained, first, by the existence of external demands on the plan of scientific and technical progress in the area of the achievement of the desired values of a number of technical and economic indicators (the increase of labor productivity, the decrease of the product cost and so on) and, second, by the need to back the assignments on the output of products with the required amount of resources.

The approaches to the formulation of the plans of production and scientific and technical development, which are presently accepted in practice and are examined in the scientific literature, presume the isolated solution of these problems. At the same time the goals of these plans and the conditions of their implementation objectively require the joint study of the problem of their formation. Thus, the allocation of resources for the production of output and the formulation and implementation of measures of scientific and technical progress is carried out from the same sources (especially for production resources), the increase of resources (the conditional increase, due to the decrease of the rates of consumption of resources) depends on the number of introduced measures of scientific and technical development, in turn the effectiveness of the measures depends significantly on the range and volume of the output being produced. Thus, on the one hand, in order to formulate the plan of scientific and technical development, it is necessary to know the production program of the enterprise and the "balance" of production resources, which it is possible to use for the implementation of measures of technical development; on the other, the specification of the production program presumes as known the increase of production resources, as well as the amount of their use for the implementation of measures of the plan of scientific and technical progress. Within the presently accepted methodology of the formulation of the technical, industrial and financial plan the sequential solution of the problems of the formulation of the plans of scientific and technical development and production is used: either the plan of scientific and technical development is chosen as primary and the production program is specified on its basis, or the production program is formulated first, and then the measures of scientific and technical development, which are aimed at its fulfillment, are chosen. The research and recommendations of scientists and specialists indicate that the former approach is more progressive, while in practice the latter is prevalent almost everywhere. However, in both cases there is the absence of "feedback"--the purposeful revision of the previously adopted plan assignments respectively with respect to the composition of the measures of scientific and technical development or the volume and range of the output being produced. In our opinion, a promising direction of the coordination of the formulation of the production program and the plan of scientific and technical development is the combination of these two particular problems into one general problem.

The problem is examined in the following formulation. The enterprise has a "backlog of orders" for items, the numbers of which form the set K. The formation of the annual production program is carried out by the choice of types of items from the known "backlog of orders" and the determination of their quantity.

The production program of the enterprise is formulated on the basis of the use of the standardized method. This means that progressive rates of consumption of resources $B=\{b_{lk}\}_{\substack{k\in K\\ l\in L}}$ (here L is the set of production resources used at the enterprise) are formulated for the production of each type of product.

If the volume of production of all types of products is described by the vector $y=\{y_k\}_{k\in K}$, the resources required for the fulfillment of the production program will come to By.

The assignments of the superior organization, as well as the direct contractual relations with client enterprises determine the permissible limits of the production of each type of product $y^{min} = \{y_k^{min}\}_{k \in K}$, $y^{max} = \{y_k^{max}\}_{k \in K}$.

The production program of the enterprise should ensure the achievement of the values set by the superior organization $P^1 = \{P_j^1\}_{j \in J_1}$ of the determined technical and economic indicators (for example, the volume of sold products, the volume of the standard net output and others). On the basis of its goals the enterprise can set the control volumes $P^2 = \{P_j^2\}_{j \in J_2}$ for the indicators, which are not approved, but are in the specific situation of great importance for the enterprise. For the formation of a production program, which satisfies the restrictions with respect to indicators from the set $J_1 \cup J_2$, it is necessary to know the contribution $S = \{s_{jk}\}_{j \in J_1 \cup J_2}^{k \in K}$ of the output of a unit of each type of product to the increase (or decrease) of the value of these indicators. Then the indicators, which correspond to plan y, will be defined as Sy.

Measures of scientific and technical development are formulated for the assurance of the fulfillment of the plan assignments and the increase of production efficiency at the enterprise. It is possible to break them down into two groups of measures: 1) those of an extensive nature, which form the set N_1; 2) those of an intensive nature, which form the set N_2. The measures from these sets are characterized by the following parameters: the need for production resources $A = \{a_{nl}\}_{l \in L}^{n \in N_1 \cup N_2}$; the need for financing from various sources $H = \{h_{nm}\}_{m \in M}^{n \in N_1 \cup N_2}$, where M is the set of sources of the financing of measures of scientific and technical progress; the contribution $V = \{v_{ni}\}_{i \in I}^{n \in N_1 \cup N_2}$ to the increase of the indicators from the set $I = J_1 \cup J_2$, the maximum permissible volume of the copying of the measures of scientific and technical development--$x^{max} = \{x_n\}_{n \in N_1 \cup N_2}$. Moreover, the measures from the set N_1 ensure the increase of resources $C = \{c_{nl}\}_{l \in L}^{n \in N_1}$, while the measures from the set N_2 contribute to the decrease of the rates of consumption of resources $G_l = \{g_{kn}^l\}_{n \in N_2}^{k \in K}$, $l \in L$, in case of the production of a unit of each types of product.

The impossibility of realizing the proposed measures of scientific and technical development as a consequence of the limitedness of time and the resources being allocated for this purpose, is a typical situation for production. Therefore the values $\{x_n\}_{n \in N_1 \cup N_2}$, which determine the number of introduced measures of the given type, are brought into line with all the measures, which "aspire" to inclusion in the plan.

The measures of scientific and technical development with a time of elaboration of more than 1 year require separate examination. These measures are excluded from examination within the framework of this problem by the use of an annual planning interval and by the partial orientation of the plan of scientific and technical development toward the goals of production of precisely

this period, since they do not ensure the receipt during the given interval of time of an impact of their introduction. Therefore the questions of the formulation of such measures of scientific and technical development are settled on the basis of goals, which are external with respect to the problem in question, for example, on the basis of the long-term program of the technical development of production. In this case, as well as given the measures mandatory for introduction the time of their fulfillment, the required resources, the influence on the indicators from set I and the increase of individual types of resources can be specified in advanced and be taken into consideration in the right-hand members of the constraints.

With allowance for the made remarks, as well as the introduced symbols the parameters of the plan of scientific and technical development can be specified: the need for production resources Ax, the need for financing Nx, the increase of resources due to measures of an extensive nature Cx, the saving of production resources due to the introduction of measures of an intensive nature $y^T G_1 x$, $1 \in L$, the change of the values of the technical and economic indicators from set I--Vx.

Now it is possible to write down the basic demands on the plans of scientific and technical development and production.

THE ACHIEVEMENT OF THE DESIRED VALUES OF THE TECHNICAL AND ECONOMIC INDICATORS

$$Sy \gtreqless \begin{pmatrix} p1 \\ p2 \end{pmatrix}, \tag{1}$$

$$Vx \gtreqless W, \tag{2}$$

where $W = \{W_i\}_{i \in I}$ is the control values of the indicators for the plan of scientific and technical progress.

THE OUTPUT OF PRODUCTS WITHIN PRESET LIMITS

$$y^{min} \leq y \leq y^{max}. \tag{3}$$

The limitedness of the volume of the copying of measures of scientific and technical progress

$$0 \leq x \leq x^{max}. \tag{4}$$

THE LIMITEDNESS OF THE USED PRODUCTION AND FINANCIAL RESOURCES

Both the production resources available at the enterprise $R = \{R_1\}_{1 \in L}$ and their increase due to meausres of an intensive and extensive nature can be used for the accomplishment of the production plan and the plan of scientific and technical development

$$By + (A-C)x - \begin{pmatrix} y^T G_1 x \\ y^T G_2 x \\ \cdots \\ y^T G_L x \end{pmatrix} \leq R. \tag{5}$$

For financial resources the conditions have the form

$$Hx \leq F, \tag{6}$$

where $F = \{F_u\}$ $u \in U$ is the maximum permissible amounts of financing from various sources.

The problem consists in the determination of production program y and the plan of scientific and technical development x, which satisfy constraints (1)-(6). In general the system of these inequalities may prove to be incompatible, which will attest to the imbalance of the plan assignments on the output of products and the control values of the approved technical and economic indicators with the resource backing. For such a situation it is advisable to change somewhat the statement of the problem. Thus, in particular, the definition of such a solution (x^*, y^*), so that in case of a fixed plan of scientific and technical development x^* among the set of all the production programs, which are permissible in the sense of constraints (1), (3), the chosen solution y^* would ensure the minimum shortage of resources, and, on the contrary, in case of a fixed production plan y^* the plan of scientific and technical progress x^* would correspond to the optimum solution with respect to the criterion of the minimum shortage, makes sense. Let us call the point (x^*, y^*), which meets these conditions, a stationary point.

An iterative scheme of the alternate formation of the production program and the plan of scientific and technical progress (the diagram) is proposed for the determination of the stationary point (x^*, y^*). At each iteration there is solved the problem of the minimization of the shortage of resources, which by means of the introduction of the additional variables $z = \{z_1\}$ $1 \in L$ is written in the following form:

for the plan of scientific and technical progress--to minimize

$$\sum_{1 \in L} z_1 \tag{7}$$

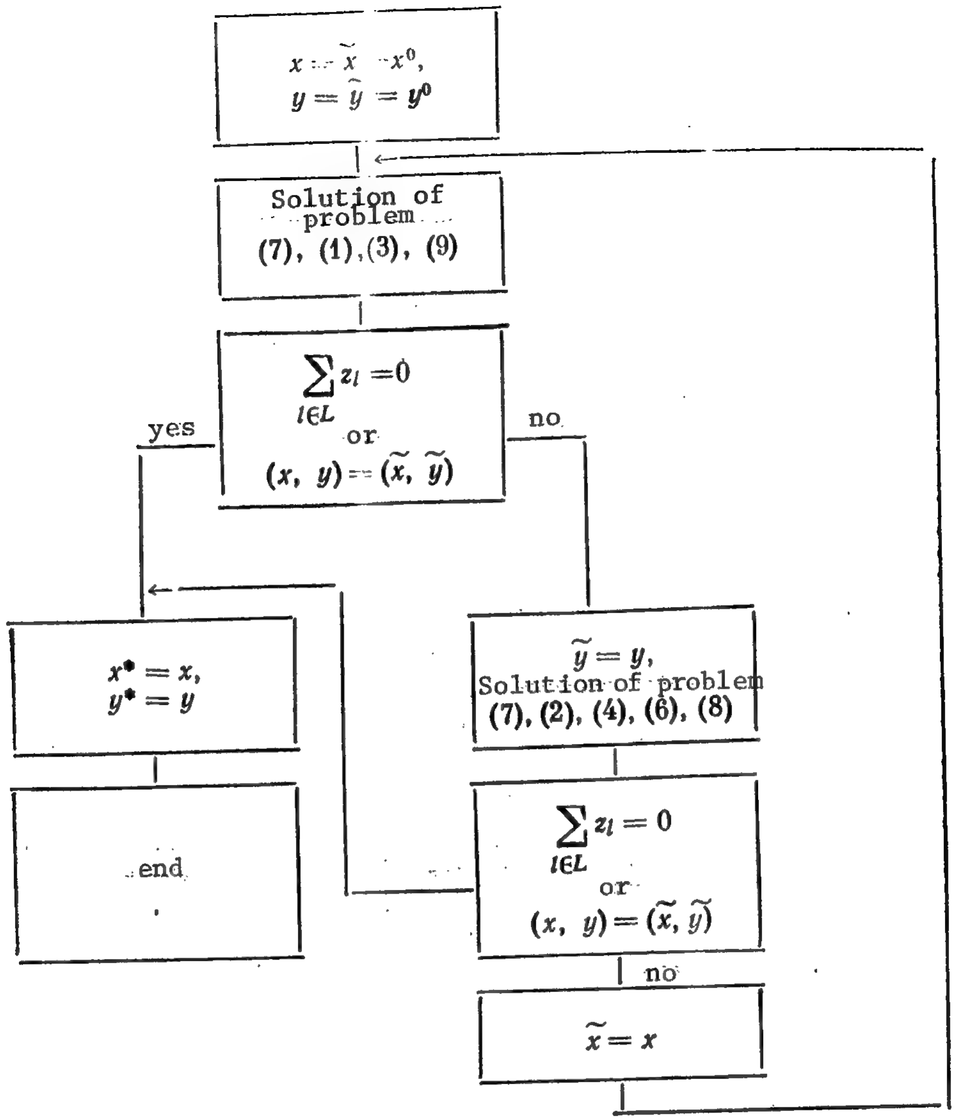
given constraints (2), (4), (6) and

$$-z+(A-C)x-\begin{pmatrix} y^T G_1 x \\ y^T G_2 x \\ \cdots \\ y^T G_L x \end{pmatrix} \leq R-By, \tag{8}$$

where y is the fixed production program, for the production plan--to minimize (7) given constraints (1), (3) and

$$-z+By-\begin{pmatrix} y^T G_1 x \\ y^T G_2 x \\ \cdots \\ y^T G_L x \end{pmatrix} \leq R+(C-A)x. \tag{9}$$

Diagram



The algorithm of the implementation of the proposed scheme of the coordination of the production program and the plan of scientific and technical development consists in the following.

1. The arbitrary plan of scientific and technical development $\tilde{x}$ and production program $\tilde{y}$ are chosen (for example, $\tilde{x}=0$, $\tilde{y}=y^{max}$).

2. The problem of the minimization of expression (7) given constraints (1), (3), (9) and the fixed vector $x=\tilde{x}$ is solved. If the obtained solution (z, y) is such that expression (7) is transformed into zero or the obtained point (x, y) coincides with the preceding point $(\tilde{x}, \tilde{y})$, go to step 4. Otherwise go to step 3.

3. The problem of the minimization of expression (7) given restraints (2), (4), (6), (8) and the fixed vector $y=\tilde{y}$ is solved. If the obtained solution (z, x) is such that expression (7) is transformed into zero or the obtained point (x, y) coincides with the preceding point $(\tilde{x}, \tilde{y})$, go to step 4. Otherwise go to step 2.

4. End of the iterative procedure. The obtained vectors $x^*=x$ and $y^*=y$ specify respectively the sought production program and plan of scientific and technical development.

The authors have demonstrated the convergence of the examined procedure to stationary point (x^*, y^*) after a finite number of steps. Moreover, the numerous calculations made for different initial data (including for real economic information) showed that the transition to a stationary point was accomplished after two to 4 semi-integrations (one semi-integration is the solution of the problem of the formation of some one type of plan).

The proposed procedure of the combined formulation of the plan of scientific and technical development and the production program has a number of advantages. First, it ensures the matching of the needs of the production plan for resources and the increase of these types of resources due to the measures of scientific and technical progress. Second, in case of the obtaining of a zero shortage of resources the obtained point (x^*, y^*) is the solution of the initial problem and the possibility exists to use in the future the existing models of the optimization of the production program. Third, the solution of arising problems is possible by the use of standard software, which is available at the computer centers of many enterprises. Fourth, the use of the proposed procedure at enterprises will not cause organizational difficulties, since it corresponds to the accepted technology of the alternate formation of these sections of the technical, industrial and financial plan.

FOOTNOTE

1. Here and below in the article NTR is scientific and technical development.

BIBLIOGRAPHY

1. Marx, K. and Engels, F., "Soch." [Works], 2d edition, Vol 46, Part II, p 213.

2. "Decree of the CPSU Central Committee and the USSR Council of Ministers 'On Measures on the Acceleration of Scientific and Technical Progress in the National Economy'," KOMMUNIST, No 13, 1983.

4. "Tipovaya metodika razrabotki tekhpromfinplana proizvodstevennogo ob"yedineniya (kombinat), predpriyatiya" [The Standard Method of Drafting the Technical, Industrial and Financial Plan of the Production Association (Combine), Enterprise], Moscow, Ekonomika, 1979.

4. Apostolov, O. P., "Nauchno-tekhnicheskiy progress--osnova povysheniya effektivnosti proizvodstva (obzor)" [Scientific and Technical Progress Is

the Basis of the Increase of Production Efficiency (A Survey)], Tashkent, 1974.

5. Kezik, I. G., "Problemy nauchno-tekhnicheskogo progressa na predpriyatii" [The Problems of Scientific and Technical Progress at the Enterprise], Sverdlovsk, Sredne-Ural'skoye knizhnoye izdatel'stvo, 1975.

6. Kozhevnikov, R., "The Economic Management of Scientific and Technical Progress," PLANOVOYE KHOZYAYSTVO, No 12, 1983.

7. Levin, I. B., "Sovershenstvovaniye planirovaniya povysheniya effektivnosti proizvodstva na promyshlennykh predpriyatiyakh v usloviyakh ASUP" [The Improvement of the Planning of the Increase of Production Efficiency at Industrial Enterprises Under the Conditions of Automated Control Systems of Enterprises], Minsk, 1979.

8. Oznobin, N. M., Pavlov, A. S., "Kompleksnoye planirovaniye nauchno-tekhnicheskogo progressa" [The Comprehensive Planning of Scientific and Technical Progress], Moscow, Mysl', 1975.

9. Sapiro, Ye. S., Gantman, Yu. L., "Means of Improving the Long-Range Planning of the Technical Development of the Industrial Association (Enterprise)," EKONOMIKA I MATEMATICHESKIYE METODY, Vol XVI, No 3, 1980.

10. Zaytsev, B. F., "Planirovaniye i effektivnost' tekhnicheskogo razvitiya ob"yedineniya" [The Planning and Efficiency of the Technical Development of the Association], Moscow, Ekonomika, 1981.

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CSO: 1814/45

ORGANIZATION, PLANNING AND COORDINATION

ANALYSIS, PREDICTION OF DEVELOPMENT OF BASIC SCIENCE

Moscow IZVESTIYA AKADEMII NAUK SSSR; SERIYA EKONOMICHESKAYA in Russian No 6, Nov-Dec 84 pp 12-26

[Article by A. Ye. Varshavskiy: "Problems of the Analysis and Prediction of the Development of Basic Science"; passages rendered in all capital letters printed in italics in source]

[Text] The basic tasks of the analysis and prediction of basic science, among which are the determination of the social and economic demands on science, the elaboration of a set of priorities of the directions and problems of scientific research and the evaluation of the prospects of the development of the scientific potential, are examined. These tasks are studied as applied to the academic sector of science, to which a leading role belongs in the conducting of basic research. Much attention is devoted to practical questions of the analysis and prediction of the development of the academic sector of science.

The task of the fundamental combination of the achievements of scientific and technical progress with the advantages of the socialist economic system has been adopted by the party and government as one of the goals of mature socialist society.

The importance accomplishing the tasks of social and economic development and the decisive role in this of science were stressed once again at the June (1983) CPSU Central Committee Plenum. "Enormous work on the development of machines, devices and processing methods of both today and tomorrow awaits us. The automation of production has to be accomplished, the most extensive use of computers and robots and the introduction of versatile technology, which makes it possible to change production over quickly and efficiently to the manufacture of new products, have to be ensured. The future of our power engineering is first of all the use of the latest nuclear reactors, and in the future also the solution of the problem of controlled thermonuclear fusion. Such tasks as the obtaining of materials with preset properties, the development of biotechnology and the extensive use in industry of waste-free and energy-saving processing methods are also on the agenda. All this will lead to a genuine revolution in our national economy" [2].

At the same time the organization of the work on the intensification of social production, as was noted in the decree of the CPSU Central Committee and the USSR Council of Ministers of 28 August 1983, "On Measures on the Acceleration of Scientific and Technical Progress in the National Economy," still does not conform completely to the task posed by the party. The accomplishment of this task is assuming especially urgent importance owing to the fact that the development of science and technology has become one of the main directions of competition between the socialist and capitalist systems [3].

The Academic Sector of Science Is the Base of Basic Research. In the USSR much attention is being devoted to basic research. On the basis of sample estimates it can be roughly calculated that the proportion of the expenditures on basic research for the country as a whole come to not less than 10 percent [6].[1]

The study of the problems of the development of basic science has been complicated by the fact that the breakdown of scientific research by stages--into basic and applied research and development--is arbitrary. Owing to this, when studying basic science it is advisable to direct one's attention not to the structure by stages, but to the organizational structure.

The basic role in the conducting of basic research in the USSR belongs to the academic sector. Rough estimates show that it accounts for about 50 percent of all the expenditures on basic research; approximately 40 percent of the basic research is conducted in the sectors and 10 percent is conducted at higher educational institutions. In this connection the prospects of basic science can be determined by the analysis and prediction of the development of the academic sector.

At the 26th CPSU Congress the leading role of basic research in the development of science as a whole was emphasized. The need for the further increase of the role and responsibility of the USSR Academy of Sciences and the improvement of the entire system of scientific research, which should be "a significantly more flexible and mobile system, which does not tolerate unproductive laboratories and institutes," was noted. At the same time it was once again indicated by the CPSU that the efforts of "large-scale science" should be focused to a greater extent "on the settlement of key national economic issues, on discoveries which are capable of making truly revolutionary changes in production" [1].

The problem of the more complete enlistment of the scientific potential of the academic sector in the solution of national economic problems also found reflection in the decisions of the December (1983) CPSU Central Committee Plenum, at which the need for "the decisive turn of ministries, departments and the USSR Academy of Sciences toward the increase of the technical level of production and product quality" [4] was indicated.

The institutions and organizations of the USSR Academy of Sciences and the academies of sciences of the union republics, as well as of sectorial academies--the All-Union Order of Lenin Academy of Agricultural Sciences imeni V. I. Lenin (VASKhNIL), the USSR Academy of Medical Sciences (AMN SSSR) and

the USSR Academy of Pedagogical Sciences (APN SSSR)--belong to the academic sector, or academic science.[2]

The bulk of the organizations in the academies of sciences are scientific research institutes with a small proportion of planning and design and technological organizations and a small number of industrial enterprises, which distinguishes academic science from sectorial science. In individual directions of research the academies of sciences in our country are in the front lines. During the 10th Five-Year Plan major results were obtained in a large number of directions of basic and applied science.

In the studies of the development of basic science a large role belongs to international comparisons. However, the comparison of economic indicators is complicated by the fact that it is impossible to recognize the existing recommendations on the classification of scientific research as ideal due to the insufficient clarity of the differentiation of individual stages. In this connection the question of the assignment to one group or another of the basic research, in the process of which not practical results, but fundamental laws might be obtained, remains unresolved; the question, to what stage one is to assign a large portion of the research in the area of the social sciences and so on, also remains open. Owing to these reasons it is inadvisable to make international comparisons of the absolute amount of expenditures of resources on basic research; in a number of instances it makes sense to analyze the rate, at which this indicator changes in different countries and which attests to the increase or lessening of the attention to basic science.

At present an increased interest in basic research is being observed both in our country and in the most developed capitalist countries. In the United States the proportion of the expenditures on basic research comes to approximately 13.3 percent, and it is important to note that in recent years it has been gradually increasing, while the proportion of scientists and engineers, who are engaged in basic research, is increasing even more rapidly and now comes to about 20 percent.[3]

The Basic Tasks of the Prediction of Science. Among the problems, which arise when predicting basic research, the following are the basic ones.

First, the determination of the social and economic demands on science (here and below the questions of the development of basic and applied science are examined, see below). These demands to a great extent determine the choice of the most important directions of scientific research for the future. Here it should be borne in mind that socioeconomic demands are of a dynamic nature and can change in case of the transition from a short-term prediction to an intermediate-term and then a long-term prediction.

Second, the determination of the priorities of the directions and the problems of scientific research. It is carried out on the basis of an expert appraisal--a survey of prominent scientists of various fields of science with allowance made for the socioeconomic demands on science and international comparisons. This phase of the prediction is the most labor-consuming and lengthy.

Third, the evaluation of the prospects of the development of the scientific potential--the manpower, material and financial resources which are necessary for conducting scientific research, as well as the elaboration of measures on the increase of its efficiency. It is necessary to take into account that the forecast evaluations and the measures being elaborated should be based on a careful economic analysis of the problems of development, in this case of academic science, for a quite long retrospective period. This is connected with the significant consequences of a large number of organizational measures in the area of science.

And, finally, the determination of the socioeconomic impact of the results of scientific research. As applied to basic and applied science as a whole it is possible to speak primarily only about the qualitative evaluation of the anticipated results of the most important directions of scientific research, which is determined according to their influence on the socioeconomic sphere and so on. Due to the lack at present of quantitative methods of evaluating the socioeconomic impact and the need to identify its qualitative characteristic for each direction of research we do not examine this stage here.

Let us merely indicate the possibility of a rough estimate of the time of the "maturation" of the results of basic research, which follows from the following assumptions. Let us assume that the expenditures on basic research $З^{фи}$ in a given year will yield with the probability P an impact after T years. We will also assume that this impact is expressed in the fact that on the basis of the results of the basic research, which was performed during the given year, applied research and development, the expenditures on which in total will come to $З^{пи+окр}$, will be conducted after T years. Given these preconditions the period of time T, during which the amount of expenditures on basic research, which has been adjusted to year t+T, will be less than the expenditures on applied science and development during the corresponding year, is determined by means of the ratio

$$З^{фи}(1+E)^{T} \leq P \cdot З_{T}^{пи+окр} \quad , \qquad (1)$$

where E is the standard of reimbursement. Since the structure of expenditures by stages of research changes within negligible limits, it is possible to assume that the ratio of the amounts of the expenditures on basic research and on applied research and development will be maintained at the existing level (approximately 1:9, see above). Then, assuming that the annual growth rate of the expenditures on science will amount on the average for the period to a, from expression (1) we will obtain

$$(1+E)^{T}=9P(1+a)^{T},$$

$$T=\ln\ 9P/\ln \frac{1+E}{1+a} \approx \frac{\ln\ 9P}{E-a} \ . \qquad (2)$$

As follows from formula (2), the time of the "maturation" of the results of basic research T given a=3 percent, P=0.5 and E=0.1 will come to 20 years, given E=0.08--30 years and given E=0.06 T increases to 50 years (for P=0.3 we will obtain respectively ~15, 20 and 30 years). In other words, given such a long period of time it makes no sense to speak about the reimbursement of the expenditures on basic science.

Thus, if we regard the expenditures on basic science as investments which ensure subsequently the possibility of conducting applied research and development, the time of the maturation of its results exceeds 20 years (the questions of the choice of the standard of adjustment are not examined here). In case of such an extremely approximate calculation it is not taken into account, of course, that basic research is the basis of the development of science as a whole and the influence of the accumulated amount of basic knowledge appears during all the subsequent time. However, its results show that when estimating the amounts of expenditures on basic science it is impossible to proceed only from the calculation of the economic impact.

THE SOCIOECONOMIC DEMANDS ON SCIENCE. The analysis of the goals of social and economic development, which are being formulated for the future, as well as the evaluation of the needs of the sectors of the national economy for the results of concrete scientific research, which aims at further technical progress, are necessary for the determination of the demands of society on science. The corresponding directive documents, as well as the long-range indicators, which are outlined by the Basic Directions of National Economic Development, the Comprehensive Plan of USSR Scientific and Technical Progress and the most important national economic and scientific and technical programs, are basic in the analysis. Here it is advisable to represent the corresponding relations between the socioeconomic sphere, technology and science in matrix form. There can be several such matrices, their common trait is similarity to the matrix like "expenditures--output."

First of all the relations between the goals of socioeconomic development and the anticipated results of scientific research should be specified in matrix form. For this it is necessary to construct a matrix, in the rows of which the basic economic and social tasks (the saving of manpower resources, materials, raw materials, energy; the achievement of efficient rates of consumption; the development of regions, especially Siberia, the North and the regions of the Far East; the improvement of the system of health care; the improvement of the system of management, planning and so on) are singled out, while the directions and problems of scientific research (electronics and computer technology, the life sciences, solid state physics, nuclear physics, space research, new processing methods and materials; research in the area of geology, environmental protection, transport; the social sciences, scientific instrument making and so on) are singled out in the columns. The majority of economic and social tasks, as well as directions of scientific research are broken down here into individual tasks and problems.

The matrices, which specify the relations between the socioeconomic tasks and the directions of technical progress, between the directions of technical progress and the directions of scientific research and, finally, between the different directions and problems of scientific research, are elaborated in a similar manner. All these matrices do not make it possible to evaluate the interrelations quantitatively. Their basic purpose consists not in the determination of the coefficients of mutual influence, as they usually attempt to do this by the expert means, but in the possibility of characterizing meaningfully at the verbal level the demands on the development of science and

of evaluating the mutual influence of individual directions of scientific research during a future period.

Let us proceed to the examination of the specific socioeconomic demands on the development of basic and applied research.

In the Basic Directions of USSR Economic and Social Development for 1981-1985 and the Period to 1990, which were adopted at the 26th CPSU Congress, there is noted the need to ensure "the further economic progress of society, profound qualitative changes in the material and technical base on the basis of the acceleration of scientific and technical progress, the intensification of social production and the increase of its efficiency" [1, p 137].

The solution of socioeconomic problems is impossible without the substantial increase of production efficiency on the basis of the acceleration of scientific and technical progress. This in turn implies the need for the increase of the growth rate of labor productivity, the stabilization, and then the increase of the output-capital ratio and the increase of the effectiveness of capital investments. By 1990 it is planned to increase the national income, which is used for consumption and accumulation, by not less than 1.4-fold [1, p 137].

The changeover to the intensive means of the development of the national economy presume a larger contribution of science to the matter of the increase of labor productivity, to the implementation of the Food Program, to the solution of the energy problem, the task of the saving of resources of physical production, questions of regional development, social tasks and the problems of the planning, management and organization of the socialist economy.

It is possible to achieve the outlined growth rate of labor productivity only on the basis of the extensive mechanization and automation of production. The most extensive use of computers and robots and the introduction of versatile technology, which makes it possible to change production over rapidly and efficiently to the manufacture of new products, have to be ensured. The indicators of the speed of highly productive computer complexes, general-purpose computers, minicomputers, microcomputers and personal computers should be increased significantly, while their unit cost should be decreased.

The implementation of the Food Program is posing for science and technical progress a number of tasks, the most important of which are the assurance of the stability of agricultural production and the development of resource-saving processing methods, the significant increase of the yield of products of light and the food industry per 1 million rubles of agricultural products.

The increase of the stability of agricultural production, the yield and gross harvests of grain and other crops is posing important tasks for genetics and breeding science. In particular, reliable breeding compensators, which counteract adverse weather conditions and decrease sharply their negative influence on the harvest, are needed. It is necessary to solve the problems of the increase of the hardiness and drought resistance, the resistance to pests and diseases and the restoration of the fertility of soils. Scientists

should develop and introduce strains which have a high potential yield. Special attention should be devoted here to the increase of the food and technological qualities. In the area of animal husbandry the improvement of the breeding and productive qualities of livestock and poultry, the development of new highly productive breeds and hybrids and the improvement of the existing ones, which have been adapted to industrial processing methods, are necessary.

The questions of the development of advanced technologies of the cultivation of high quality seed of grain and other crops (seed growing agricultural technology) are important. The need for the increase of the technical level of agricultural machinery is making great demands on science. Energy-saving soil-protection and industrial technologies of the cultivation of agricultural crops and advanced technologies of the production of high quality fodders and the storage of agricultural products should be developed and introduced [5].

Power engineering is posing serious problems for science. In the area of power engineering the proportion of nuclear energy in the production of energy resources will increase rapidly. According to some predictions, the share of atomic energy throughout the world will come to 40-50 percent of the total generation of electric power [7]. At the same time in the forming situation with fuel and energy resources great importance is being attached to their saving. As a whole on the basis of the achievements of scientific and technical progress the power-output ratio of the final national product should be decreased substantially.

In the area of construction materials it is necessary to make significant structural changes in favor of the most advanced types and to improve the qualitative characteristics of the materials being used, which will make it possible to decrease significantly the materials-output ratio. Here the changeover to advanced technologies of the obtaining of metal and the radical improvement of its quality are the main problems; it is necessary to ensure the acceleration of the rate of the annual saving of rolled products. The results of scientific research should yield new methods of the obtaining, hardening and machining of metals and new technologies of continuous processes--from smelting to the final finishing of metal products.

During the future period the process of the relative replacement of ferrous metals with plastics will continue. The lead of the increase of the volumes of output of plastics with respect to the production of ferrous metals should increase. For the accomplishment of this task it is necessary to develop new, efficient large-tonnage processes, which will become possible as a result of research in the area of catalysis.

Means of the more rapid growth of nonferrous metallurgy should be found. The research in the area of the complete utilization of mineral deposits will play a large role in the solution of this problem.

The increase of the yield of the final product per unit of initial wood raw materials is the central problem of the development of the timber, wood processing and pulp and paper industry. The research on the increase of the

completeness of the processing of timber resources and the achievements of chemical technological sciences will make it possible to solve it.

During the future period the role of science in offsetting the limitedness of several important types of minerals will increase. The rapid regional large-scale geological study of the territory of the USSR and the more efficient use of the achievements of all the earth sciences are necessary for the assurance of a stable mineral raw material potential of the country. In recent years the increase of the proven reserves and the assurance of the increase of the extraction of raw material, fuel and energy resources have been occurring primarily due to the remote and hard to reach regions of the North, Siberia and the Far East. During the coming 20-year period the development of these regions on the basis of the achievements of science and technology will be of great national economic importance. An important role in the accomplishment of this task will belong to the research on the development of new means of transportation.

The need for profound qualitative changes in the productive forces and the improvement of production relations is a distinctive trait of social development at the present stage. The research in the area of the social sciences should make a significant contribution to the assurance of the continuous operation of the entire economic mechanism. Science should suggest to practice the choice of the most reliable means of increasing production efficiency and product quality and the principles of scientifically sound pricing. The formulation of a unified scientific and technical policy is assuming decisive importance. The elaboration of a set of organizational, economic and social measures, which would ensure an interest in the updating of equipment, is necessary. The development of research in the area of planning should contribute to the elimination of such shortcomings as the unjustified dispersal of resources and the imbalance of plans. The further development of the principles of democratic centralism in the management of the national economy and in the making of economic decisions is necessary. The task of science is to find new means and directions of the economic integration of the countries of the socialist community and to promote its transition to a qualitatively new level [2].

The development of health care, which is posing for medical science the tasks of decreasing the death rate and increasing the life expectancy, is of great importance in the solution of social problems.

The further development of the system of education in conformity with the increased demands of the national economy on the quality of the training of personnel is a major social problem. The pedagogical sciences should make a significant contribution to the accomplishment of such tasks as the broadening of the creative basis in the educational process, the increase of the role of labor education, the improvement of the structure of the training of personnel, the timely changeover to new specialties and the decrease of the training of specialists, the need for whom is exhausted.

THE IMPORTANCE OF THE PRIORITY DEVELOPMENT OF BASIC RESEARCH. Under the conditions of the limitation of manpower and several material resources the

uniform development of all directions of science as a whole is impossible. The only acceptable means is the priority development of the most important directions of scientific research, which is aimed at the solution of socioeconomic problems, the creation of the foundation for the acceleration of the progress of sectorial science and the further strengthening of the prestige of domestic science abroad.

The changes in the priorities of scientific research to a large extent anticipate the structural changes in technology and production of the future. Thus, the bringing to the forefront of the life sciences, which include the biological, medical and agricultural sciences, has become more significant in the reform of the interdisciplinary proportions of basic science abroad. This occurred, on the one hand, as a result of the overall change of the trends of economic and social development and the increasing role of the food problem under the conditions of the drastic change of the demographic situation. On the other hand, the achievements of basic science as a whole became the basis for such a structural reform. It is characteristic that in the sphere of higher education a leading rate of the training of specialists in biology, agriculture and medicine was observed already in the 1960's and 1970's.

The priority directions of scientific research abroad, which pertain to military weapons and technical equipment, should be specially singled out. In this connection it is possible to indicate the ranked list of 17 technologies, the development of which, as is assumed, will make it possible to increase by 10-fold the potentials of future generations of weapons (this list was used when preparing the draft of the 1984 U.S. defense budget). Among them are ultra high-speed integrated circuits, a "stealth" advanced bomber, advanced software and algorithms, microprocessor means of the instruction of personnel, fail-proof and defect-proof equipment, fast-hardening materials, computer intelligence, supercomputers, advanced composite materials, advanced radiation-proof equipment, space nuclear engines, powerful microwave oscillators, large space structures, space-based radar stations and shortwave lasers [13].

In the socialist countries exceptionally great attention is being devoted to the determination of the priority directions of scientific research. Thus, the state long-range plan of scientific research of Hungary distinguishes 18 state scientific research tasks, which are divided into two groups: a) the statewide main directions of scientific research (research in the area of solid state physics, biological regulation and biologically active chemical compounds, the development of the system of state administration, pedagogical research, the improvement of the socialist enterprise, the further development of economic policy) and b) the state goal programs of scientific research (the development of the aluminum and petrochemical industry, electronic computer engineering, construction methods on the basic of light-weight components, research in the area of the most favorable formation of the macro- and micro-environment of man, production technologies, electronic components, information systems and equipment, the increase of soil fertility, the development of meat production, the enlargement of the selection of food products and new directions of their processing and storage). It is characteristic that three of the seven main directions of scientific research

have as a goal the improvement of the system of administration, management and economic policy.

In Hungary 30-40 percent of the scientific potential of the country is oriented toward the fulfillment of statewide scientific research tasks. In addition to statewide tasks more than 100 sectorial tasks are being elaborated by the forces of approximately 20-30 percent of the scientific potential [8].

In our country the selection of the most important directions of scientific research on the statewide level is being carried out within the formulation of the Comprehensive Program of USSR Scientific and Technical Progress.

The structure of the comprehensive program reflects the prospects of the development of science and technology and the regional, international and socioeconomic aspects of the anticipated development, which are being elaborated in the corresponding sections of the comprehensive program. The prospects of the development of science are evaluated on the basis of the identification of the most important directions with allowance made for their priority, and all the spheres of scientific development: basic and applied research, experimental design operations and their introduction in the sectors of the national economy, are covered. The scientific potential, the possibilities of the use of the achievements of science abroad, as well as the problems of regional scientific development, which are of great importance for the vast territory of the Soviet Union, are also subject to evaluation [8].

PRACTICAL QUESTIONS OF THE DETERMINATION OF PRIORITIES. In the formulation of the set of priorities of the directions of scientific research let us first of all note the existence of several levels of aggregation. First experts specify the problems and directions, which are, in their opinion, most important and vital. Further they are aggregated into consolidated directions of scientific research. Then from the consolidated directions the experts of the highest level specify those which have the highest priority. Such a multilevel set of priorities of scientific research corresponds best to the demands on the part of the socioeconomic sphere and technical progress. It should be borne in mind that the changes in the structure of the set of priorities are most significant at the level of problems and subproblems and are slowed down and less pronounced at the level of the directions of scientific research.

The procedure of conducting the survey as a whole does not differ from the previously developed ones [9]. However, it has peculiarities at each level of aggregation. At the level of individual problems within one direction the questions asked to the experts require the characterization of quite narrow problems and frequently can be evaluated quantitatively. But for higher levels of aggregation, at which the most prominent scientists (primarily members of the USSR Academy of Sciences) are enlisted in the appraisal, the questions, as practice shows, should be of a most general nature so as not to limit the initiative of the expert. When conducting the survey at these levels that fact that the number of rounds here cannot be large, should also be taken into account.

A specially prepared questionnaire together with written rules, instructions and a tentative list of directions of scientific research was sent to the experts for the expert appraisal of the most important directions of scientific research.

The questionnaire contained only three questions; the expert should have indicated, what most important achievements in science, in his opinion, could be expected, and should have given a brief description of their possible results with an indication of the directions of scientific research, to which the achievements singled out by him belong, as well as should have specified the time of the obtaining of the basic results (maximum and minimum). In the instructions on the filling out of the questionnaire it was explained that in the first column of the questionnaire the expert should indicate the most important achievements in domestic science, which are anticipated by him and change significantly the established trends of the development of science, technology or sectors of the national economy (including the achievements which will make it possible to overcome the lag in individual directions), and give a brief description of the possible results. The number of the direction (or the numbers of the directions) of scientific research, in which the expert anticipates the appearance of the achievements named by him, should have been indicated in the second column; the expert was reminded that a list of consolidated directions of scientific research is given in the supplement; moreover, if he considered it necessary, he could make more precise or expand this list. In the third column it was necessary to indicate the anticipated time of the obtaining of the basic results: the maximum (with allowance made for the really existing limitedness of resources) and the minimum (under the conditions of the complete supply with the necessary resources given the intensification of scientific research work).

It is obvious that such a nature of the questionnaire does not make it possible to ensure a sufficiently high level of the formalization of the procedure of processing the results. The basic difficulty of the procedure of processing the results of an expert appraisal consists in the thorough qualitative analysis of the expert appraisals, their ordering, comparison and combination into groups, which correspond to several consolidated directions of scientific research, which have the highest priority among all the others. The use of standard methods of the statistical processing of expert appraisals was possible, obviously, only in those instances when several experts singled out the same achievement as the most important one.

It should also be noted that as a result of such a survey it is impossible to single out among the priority directions of scientific research the most important ones. This found its confirmation in the uniformity of the breakdown of the responses of the experts by consolidated directions. The opinion of experts of the highest level, who are capable of evaluating the long-range development of all the directions of scientific research as a whole, was taken into account in order to single out the directions with the highest priority (about 20 percent of those deemed most important).

For the distinction of the priority problems with a priority direction the procedure of the survey was more complicated (at this level it was approved for one of the most important directions of scientific research).

Tables with a detailed list of questions, the responses to which could be evaluated quantitatively, were sent to the expert. The first of these tables was elaborated on the basis of the matrix approach, which is used when determining the demands on science on the part of the socioeconomic sphere and technical progress (see above). When filling it out, the expert, having formulated a list of the anticipated achievements, should have indicated, in what directions of scientific research, sectors, works and processing methods their results can be used. Moreover, it was required of the expert to indicate the associated directions of scientific research, without the development of which this achievement cannot be obtained. In the following tables it was necessary to give a description of the anticipated socioeconomic results; to indicate, on the basis of what it is possible to predict each of the achievements named by the expert; to specify the conditions, which are necessary for their implementation, the time (maximum and minimum), the level of the corresponding research abroad and, finally, to give his own ranking of the distinguished achievements in conformity with specific criteria.

Obviously, the basic difficulties of the use of this approach for the prediction of the development of scientific research as a whole consist in the impossibility of covering completely all the problems in all the directions of research, as well as organizing and managing the extremely large collective of experts, which it would be necessary to create for this purpose. Therefore it can be suggested only for the most priority directions of scientific research. The possibility of obtaining a high degree of agreement of the appraisals of experts is its merit.

At the same time it was necessary to take into account that an adequate amount of information for the characterization of the most important directions of scientific research is not always contained in the responses of experts of the highest level. Departments of the USSR Academy of Sciences and sectorial academies (which are represented by the corresponding subdivisions) were enlisted in the work on prediction in order to obtain the required information. The materials prepared by them along with the responses of the experts of the highest level made it possible to obtain a more complete characterization of the anticipated results of the most important directions of scientific research for the future and the possibility of solving socioeconomic and technical problems (see above).

THE PRIORITIES OF THE DIRECTIONS OF SCIENTIFIC RESEARCH. The set of priorities of scientific research, which was formulated in accordance with the results of the survey of prominent Soviet scientists, also takes into account the socioeconomic demands on science, as well as the achievements of science abroad. As was noted by Vice President of the USSR Academy of Sciences Academician V. A. Kotel'nikov, the following directions deserve particular attention [10].

First, ELECTRONICS AND ELECTRONIC COMPUTER TECHNOLOGY, which have a large influence on the development of practically all the sectors of the national economy and create the conditions for the substantial increase of labor productivity and the elimination of difficult and monotonous labor.

Third, RESEARCH IN THE AREA OF POWER ENGINEERING, which will provide new means of obtaining fuel and power and thus will make it possible to offset the anticipated shortage of natural fuel resources, as well as to use fuel and energy resources more efficiently. A large role belongs to research in the area of the obtaining of synthetic liquid fuels from coal and shales and to the work on thermonuclear fusion in the solution of the energy problem. The development of one of the most promising methods of converting fuel energy into electric power--the magnetohydrodynamic method--will make it possible to decrease the specific consumption of fuel and to increase the maneuverability of electric power plants. On the basis of the research in the area of the recovery and refining of petroleum the increase of the thoroughness of its refining and the increase of the petroleum recovery ratio are anticipated. The research in the area of the production and use of hydrogen as an energy carrier, in the area of alternate energy sources and on the development of new chemical sources of electric energy will be of great importance.

Third, THE IMPROVEMENT OF TECHNOLOGY, which is based on the achievements of physics, mechanics, chemistry, biology, electronics and a large number of other sciences and affects practically all the sectors of the national economy and industry. Many achievements here are connected first of all with research in the area of catalysis, with the development of waste-free processing methods, with the development of the laser processing of materials, powder metallurgy and so on. In particular, the achievements in the area of catalysis will make it possible to carry out the industrial processing of heavy fractions of petroleum, coal and raw materials of vegetable origin and to develop highly efficient processes of the obtaining of ethylene and propylene from methanol.

Fourth, THE LIFE SCIENCES, the role of which in the USSR will increase in the future. The biological and agricultural sciences and research in the area of medicine are included among them. The research in the area of enzymology, immunology and genetic engineering, the work on the study of lipids, membrane phenomena, photosynthesis, microbiology, plant physiology, hybridization, neurobiology, neurophysiology and others are the most important directions here.

The biological factor (on the condition of the assurance of the necessary level of the use of chemical agents, machines and equipment) is decisive in case of the accomplishment of the Food Program. Owing to this the operations on the development of new strains and species of plants with preset properties, on the increase of the productivity of breeds of livestock, on the improvement of soils, the increase of their biological productivity and protection against water and wind erosion, on the elaboration of effective biological methods of the protection of agricultural plants against pests, diseases and weeds, on the development of new types of fertilizers, on the obtaining of fodder and food protein, as well as in the area of the development of more advanced labor-saving processing methods and equipment and the increase of the reliability of machines for agriculture are the priority operations among the research in the area of the biological and agricultural sciences.

The achievements in immunology and genetics will make it possible to develop antineoplastic preparations, means of the prevention and restoration of the disturbed functions of the body, first of all the cardiovascular system, from diseases of the circulatory system. The further development of medical science will also lead to the determination of the causes and mechanisms of the occurrence of tumors, to the development of effective means of the suppression of allergic reactions, methods of the diagnosis and treatment of several hereditary diseases, to the development and transplantation of artificial organs and so on.

The results of biological research will have an effect on the development of many sectors of industry and the national economy. In particular, the development of biotechnology and enzymology, the study of biological membranes and so on will lead to the appearance of new highly efficient technological processes.

THE STUDY OF THE STRUCTURE OF THE EARTH AND THE IMPROVEMENT OF THE SEARCH FOR MINERAL RESOURCES are of great importance. This research will make it possible to solve the problem of compensating for the depletion of natural resources and will afford the opportunity to begin the systematic use of the resources of the ocean and of minerals, which occur at great depths, and the complete extraction of components from complex ores. The geological estimate of the potential resources and recovery of combustible minerals, the development of methods and equipment for operations at great depths, new geophysical methods of the search for mineral resources, first of all petroleum and gas reservoirs, techniques of the complete extraction of components from complex ores and others will be of great importance.

An important role is being allotted to THE FORECASTING OF THE WEATHER AND CLIMATE CHANGES, including those caused by the activity of man. The research in the area of environmental protection and the efficient use of natural resources, the study of the biology of the ocean and oceanic biological resources, the formulation of the biological principles of combating the pathogens of the most dangerous parasitic diseases of man and animals and others will yield a significant socioeconomic impact.

In the area of THE SOCIAL SCIENCES the research, which is aimed at the improvement of the management and planning of the national economy, the increase of the efficiency of social production and the growth of labor productivity, the stimulation of scientific and technical progress, the formulation of the scientific principles of the socialist way of life and the formation of socioeconomic needs, the study of the laws of the social development of society, the improvement of the educational system, the strengthening of the legal basis of state and public life, the assurance of the priority of national, state interests and the study of the laws of the world socialist system and the problems of the economy and policy of the capitalist and developing countries, is especially urgent.

Among the other priority directions of scientific research Academician V. A. Kotel'nikov named the research in the area of nuclear physics, including elementary particle physics, and space.

The development of research and development in the area of scientific instrument making will play a decisive role for the substantial increase of the effectiveness of science. It is important to note that the lack of the necessary scientific instruments in some fields of science can serve as the source of a lag in other directions of research.

The development of scientific instruments and equipment will proceed in the direction of the broadening of their potentials and range and the increase of the accuracy, reliability and degree of automation. This will make it possible to increase significantly the effectiveness of scientific research.

THE PROBLEMS OF PREDICTING THE DEVELOPMENT OF THE SCIENTIFIC POTENTIAL. The estimate of the long-range indicators, which characterize the potential of academic science, is based on the analysis of the problem of the development of its basic components--manpower, financial and material resources, on international comparisons and a subsequent standard prediction. Here measures on the increase of the effectiveness of scientific research are also elaborated.

At present the number of scientists in the academic sector of the USSR has reached nearly 128,000, among whom there are 66,500 (or more than 52 percent) specialists of the highest skill--doctors and candidates of sciences (as a whole for the USSR the proportion of scientific personnel of the highest skill in the total number of scientists and science teachers comes to approximately 30 percent) [11]. Without regard for the scientists and science teachers of higher educational institutions more than 17 percent of all scientists, 53 percent of all doctors of sciences and 34 percent of all candidates of sciences are concentrated in academic science. Such a high qualitative composition of the personnel potential also governs the corresponding level of the research being conducted at the academies of sciences, among which the central place belongs to USSR Academy of Sciences.

The bulk of the manpower resources of academic science is concentrated in the USSR Academy of Sciences and the academies of sciences of the union republics--at their scientific institutions, design bureaus, industrial and other organizations (table).

Let us examine the basic problems of the development of the manpower resources of the academic sector. They are due in many ways to the slowing of the increase of the number of workers, including scientists at academic scientific research institutions (at the USSR Academy of Sciences and the academies of sciences of the union republics, which make up the bulk of the academic sector; the average annual growth rate of the number of scientists during the 9th and 10th Five-Year Plans was ten-thirteenths as great as in science as a whole [11]). Among these problems one should single out the increase of the average age of scientists, the lower level of the wage of those employed in science and the questions of the training of scientific personnel and so on.

The increase of the average age of scientists is a consequence of the very rapid increase of their number in the 1960's and at the very beginning of the 1970's and the subsequent decrease of the rate of its increase. Apparently, measures, which stimulate the transfer of a portion of the scientific

personnel of older ages (starting at approximately 35-40) to the sector of science of higher educational institutions and the sectorial sector of science, to the sphere of management and education, to production and so on, should be elaborated for the academic sector.

Structure of the Scientific Personnel of the Academies of Sciences, thousands/percent* (1981)

	Number of scientists	Percent	Number of doctors of sciences	Percent	Number of candidates of sciences	Percent
USSR Academy of Sciences and academies of sciences of union republics..	99.5	77.8	7.86	82.1	43.4	76.3
Of them:						
USSR Academy of Sciences..........	49.1	38.4	4.77	49.8	22.6	39.7
Academies of sciences of union republics...	50.4	39.4	3.09	32.3	20.8	36.6
All-Union Academy of Agricultural Sciences imeni V. I. Lenin.........	19.8	15.5	0.58	6.1	8.7	15.3
USSR Academy of Medical Sciences....	6.8	5.3	1.00	10.4	3.9	6.8
USSR Academy of Pedagogical Sciences............	1.7	1.3	0.13	1.4	0.9	1.6
Total...............	127.8	100.0	9.57	100.0	56.9	100.0

*Calculated according to [11].

The problem of the higher quality training of scientific personnel of the academic sector in many ways is governed by the inadequate training of graduate students by the leading scientific research institutes in case of a high level of this indicator at scientific institutions, which are smaller and are not always sufficiently well supplied with highly skilled scientific personnel and the required material resources. Thus, it is characteristic of the USSR Academy of Sciences and the academies of sciences of the union republics that the number of graduate students at the academies of sciences of the union republics is greater than at the USSR Academy of Sciences, with a significantly smaller number (five-eighths as many [11]) doctors of sciences. Moreover, in the academic sector there are fewer graduate students per doctor of sciences than in the other sectors--the sector of higher educational institutions and the sectorial sector (at the USSR Academy of Sciences and the academies of sciences of the union republics, as calculations show, there are approximately 40 percent fewer graduate students per doctor of sciences than

in the entire sphere of scientific research and experimental design work as a whole).

The analysis of the problems, which are connected with the manpower resources of the academic sector, makes it possible to formulate the necessary standards for the prediction of the number of scientific personnel (here the anticipated demographic situation, the possible growth rate of the number of those employed in science as a whole, the need for the preferential development of basic research and so on are taken into account).

As a whole when evaluating the prospects of the development of the manpower resources of the academies of sciences the following questions should be examined:

the study of the dynamics of the age structure of scientific personnel and the formulation of measures, which stimulate the transfer of a portion of the scientific personnel of older ages to other sectors of science and spheres of activity for the purpose of increasing the influx into the academic sector of creatively talented young people and averting the excessive aging of scientific personnel;

the determination of the optimum ratio of scientists and auxiliary personnel at scientific research institutions;

the improvement of the training of scientific personnel, particularly in graduate studies;

the development of the network of scientific research institutions in regions of the country, which are being newly developed (Siberia, the Far East, the European North).

The solution of the problems, which face academic science, requires the maintenance in the future of a sufficiently high growth rate of financial and material resources.

For the intensification of research in the area of basic and applied science it is necessary to increase the level of the provision of scientists with instruments and equipment, materials and reagents. Here the slowing of the increase of the level of supply of scientific personnel, which was observed during the 10th Five-Year Plan, should be overcome [12]; the proportion of the material expenditures in the total amount of the current outlays on academic science should increase, which will lead to the acceleration of the increase of the machine-worker ratio of scientists.

The existence of significant differences in the breakdown of expenditures per scientist by individual academies is a serious problem. It should be noted that in the past decade the increase of the number of scientists at the USSR Academy of Medical Sciences, the USSR Academy of Pedagogical Sciences and especially the All-Union Academy of Agricultural Sciences imeni V. I. Lenin occurred significantly more rapidly than at the USSR Academy of Sciences and the academies of sciences of the union republics, while the increase of the amount of current expenditures was slower; in turn, at the academies of

sciences of the union republics the increase of the number occurred more rapidly than at the USSR Academy of Sciences. This attests that the All-Union Academy of Agricultural Sciences imeni V. I. Lenin, the USSR Academy of Medical Sciences, the USSR Academy of Pedagogical Sciences and the academies of sciences of the union republics are still being developed to a significant extent by the extensive means.

In connection with the fact that in the academic sector primarily basic research, which is the basis for the successful development of applied science and development, is being conducted, it is necessary also in the future to ensure the leading development of academic science. Here a number of the problems, which face researchers, should be noted. In particular, at present the problem of comparing the fixed capital of the academic sector and the sector "Science and Scientific Service" (NNO) has not yet been solved. The amount of the proportion of the fixed capital of academic science in the total amount of fixed capital of the sector "Science and Scientific Service" is arbitrary due to the statistical difficulties of recording the fixed capital of "Science and Scientific Service" and the academies of sciences. Thus, for example, a number of pilot works, plants, scientific stations, design bureaus and so on are not taken into account in the sector "Science and Scientific Service," but are assigned to the sectors of physical production. The problems of the statistical recording to scientific personnel are dictated by the difficulties of the classification of the workers, who are engaged directly in scientific research, as well as attendants. Moreover, the breakdown of resources by stages of scientific research and experimental design work, by directions and problems of scientific research and others is not taken into account in the statistics.

Wages constitute a significant proportion of the current expenditures on scientific research. Owing to this they are a most important lever of the intensification of the labor of those employed in science. There exist here its own problems, which require solution. The point is that during the past 20-year period the growth rate of the wages of those employed in academic science has been less than in a number of sectors of the national economy. If the established trend of the change of the ratio of the level of wages in science and in the sectors of the national economy is maintained, this can promote the diversion of young capable personnel from science, including from the academic sector.

As a whole when evaluating the prospects of the material supply of academic science there should be determined (in accordance with several versions):

the indicators of the resource-worker ratio of those employed and scientists by directions of scientific research;

the amounts of capital investments and areas being put into operation by 5-year periods;

the indicators of the supply with scientific instruments and equipment and the need for them (by the most important groups of instruments);

the level of the wages of those employed in academic science.

It is also necessary to examine the questions of the development of the information base of academic science and the problems of the improvement of publishing activity.

The increase of the effectiveness of the basic and applied research, which is being conducted at the academies of sciences, should be based on the increase of the labor productivity of those engaged in scientific research and on the improvement of the system of the planning and management of academic science.

The increase of the labor productivity of the scientific personnel of the academic sector should be connected first of all with the development and extensive dissemination of means of the automation of scientific research, new generations of scientific instruments and equipment, computer systems and personal computers. The creation of specialized data banks in individual fields of research will also contribute to the increase of labor productivity in academic science. Thus, the survey of prominent Soviet scientists identified the need for the creation of a bank of the thermodynamic properties of substances.

As was indicated above, for the strengthening of material interest and the increase of the prestige of academic science it is necessary to increase significantly the remuneration of the labor of those engaged in basic and applied research, having linked it with the end results, and to strengthen the system of incentives for great scientific results.

The increase of the quality of the training of highly skilled personnel is playing an important role in the increase of the labor productivity of scientists. The academic sector in the level of skills of scientists can be the base for the training of scientific personnel for the sectorial sector of science and the sector of science of higher educational institutions. Owing to this, as Academician V. L. Ginzburg suggests, it is advisable to organize on the basis of the academic sector graduate studies with open competition for all young specialists of the countries with their subsequent assignment. The improvement of the work of the graduate studies of the academic sector should proceed in a large number of directions. In particular, the training of graduate students should be concentrated at the leading scientific research institutions (NIU's) of the academies of sciences; for the increase of the level of the training in special-purpose graduate studies of scientific personnel for the academic scientific research institutions of the union republics it is advisable to introduce practical studies before enrollment in graduate studies; the requirement of the submitting and defense of the graduate student of a dissertation project by the time of the completion of graduate studies should be revised.

The problems of improving the planning of the academic sector are dictated by the problems which face science as a whole.

The interconnection of the different sections of the plan, the affording of greater opportunities to the executives of scientific research institutions for the shifting of resources for the purpose of their rapid redistribution for the development of the priority directions of scientific research, the

supplementing of the prevailing system of funds with reserve and special-purpose funds for the time of the performance of scientific research operations, the increase of the mobility of the themes of research, the more extensive dissemination of the experience of the establishment of temporary subdivisions on the basis of academic scientific research institutions, the proper choice of the specialization of regions and other measures will make it possible to increase even more the effectiveness of academic science. For the elaboration of all these measures the conducting of the corresponding experiment for a limited number of scientific institutions of the academic sector is advisable.

FOOTNOTES

1. In the USSR a special record of expenditures by individual stages of scientific research and experimental design work is not kept. At present in our country the study of the laws of nature and society regardless of their specific practical applications is assigned to basic research; the study of the laws, which were discovered as a result of basic research, for the purpose of their specific practical use is assigned to applied research; the work, which is based on acquired knowledge, on the development of new and the significant improvement of existing materials, products, technological processes, systems and methods is assigned to development.

2. The problems of the development of the USSR Academy of Arts and the RSFSR Academy of Municipal Services are not examined due to their specificity.

3. The academic sector is the basic performer of basic research in the United States. Universities and colleges (their share with respect to expenditures comes to more than 73 percent), as well as government-financed research centers, which are managed by universities and at which the majority of research is conducted in the area of the technical, physical mathematical and chemical sciences, are a part of it. In 1980 the share of the academic sector of the United States in the current expenditures on the basic research being performed in the country came to approximately 60 percent, while the proportion of basic research proper in the academic sector was equal to 60 percent [14].

BIBLIOGRAPHY

1. "Materialy XXVI s"yezda KPSS" [Materials of the 26th CPSU Congress], Moscow, Politizdat, 1981.

2. "Materialy Plenuma TsK KPSS. 14-15 iyunya 1983 goda" [Materials of the CPSU Central Committee Plenum. 14-15 June 1983], Moscow, Politizdat, 1983, p 10.

3. "The Decree of the CPSU Central Committee and the USSR Council of Ministers 'On Measures on the Acceleration of Scientific and Technical Progress in the National Economy'," PRAVDA, 28 August 1983.

4. "Materialy Plenuma Tsentral'nogo Komiteta KPSS. 26-27 dekabrya 1983 goda" [Materials of the CPSU Central Committee Plenum. 26-27 December 1983], Moscow, Politizdat, p 14.

5. "Prodovol'stvennaya programma SSSR na period do 1990 goda i mery po yeye realizatsii. Materialy mayskogo Plenuma TsK KPSS 1892 goda" [The USSR Food Program for the Period to 1990 and Measures on Its Accomplishment. Materials of the May CPSU Central Committee Plenum of 1982], Moscow, Politizdat, 1982.

6. Pirogov, S. V., "Upravleniye naukoy" [The Management of Science], Moscow, Mysl', 1983.

7. Petros'yants, A. M., "Atomnaya nauka i tekhnika--narodnomu khozyaystvu" [Atomic Science and Technology for the National Economy], Moscow, Energoizdat, 1981.

8. "Upravleniye nauchno-tekhnicheskim razvitiyem v usloviyakh sotsializma" [The Management of Scientific and Technical Development Under the Conditions of Socialism], Moscow, Progress, 1982.

9. Larichev, O. I., "The Analysis of the Processes of Decision Making by Man in Case of Alternatives Which Have Evaluations According to Many Criteria," AiT, No 8, 1981, pp 131-141.

10. Kotel'nikov, V. A., "Problems of the Long-Range Planning of Scientific and Technical Progress," PLANOVOYE KHOZYAYSTVO, No 7, 1979, pp 44-49.

11. "Narodnoye khozyaystvo SSSR v 1922-1982 gg." [The USSR National Economy During 1922-1982], Moscow, Finansy i statistika, 1983.

12. Varshavskiy, A. Ye., "Problems of the Development of the Scientific and Technical Potential," IZVESTIYA AKADEMII NAUK SSSR. SERIYA EKONOMICHESKAYA, No 6, 1983, pp 36-46.

13. ELECTRONICS, No 9, 1982.

14. "Science Indicators," New York, 1980.

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CSO: 1814/48

ORGANIZATION, PLANNING AND COORDINATION

PROPORTIONALITY IN SCIENTIFIC, TECHNICAL PROGRESS

Moscow EKONOMICHESKIYE NAUKI in Russian No 9, Sep 84 pp 49-55

[Article by Candidate of Economic Sciences Docent F. Rybakov (Leningrad): "Proportionality in the Sphere of Scientific and Technical Progress"]

[Text] The combination in practice of the achievements of the scientific and technical revolution with the advantages of socialism is being accomplished by means of the unified scientific and technical policy. It is in the most general form a set of economic, organizational and social measures, which are implemented by socialist society through the organs of state management and the primary units of social production for the purpose of the creation of the most favorable conditions for the development of science and technology and the quickest introduction of scientific and technical achievements in production. The unified scientific and technical policy, while based on the use of the most important advantage of socialism--the planned and proportionate development of the national economy--at the same time acts as a form of the realization of proportionality in the sphere of scientific and technical progress.

The realization of this form begins with the scientifically sound determination of the needs of social production of the elaboration some scientific and technical problems or others. This is embodied concretely in the Comprehensive Program of Scientific and Technical Progress, which is designed for a 20-year period. Here the proportions, which form in the unified national economic complex between science, technology and production, are of particular importance. Thus, back in 1961 at the All-Union Conference of Scientists at the Kremlin it was noted: "Given all the complexity and diversity of the interrelations of science and technology with physical production it is obvious that for the all-round development of physical production the rate of development of technology should exceed the rate of development of production, while science should develop more rapidly than technology develops."[1] In the practice of socialist planning the named proportions are realized in the distribution of forces and assets between the sphere of science and scientific service; the planning and designing of new equipment; science and production directly, that is, by all the stages of the science-production cycle. And here, in our opinion, the assurance of a high growth rate of the productivity of national labor should serve as the criterion.

In the "science--technology--production" system, the problems of the proportionality of which are being discussed quite extensively,[2] the decisive role, as was established by K. Marx, belongs to physical production, which takes precedence with respect to spiritual production.[3] But the process of the interaction of science, technology and production should not be understood as a well-defined, one-sided connection which runs from production to science and technology. This process is far more complicated. F. Engels in "Dialektika prirody" [The Dialectics of Nature] noted: "So far they have boastfully shown off only that for which production is obliged to science; but science is obliged to production for infinitely more."[4] In the works of the classics of Marxism-Leninism the dialectics of the determination of the interconnection of science, technology and production is examined first of all from the position of historical interaction. Science originated in the sphere of social consciousness, but under the influence of the needs of production. "If a technical need appears in society, this advances science more than 10 universities."[5] In turn, the practical activity of people is the criterion of scientific truth. Science is governed by production, contributes to its further development and improvement, but at the same time has its own logic of development. Society, when determining the proportions between science, technology and production, should take into account the leading amount of expenditures on scientific research and experimental design work with respect to the assets which are being allocated for the expansion of physical production proper. During the 11th Five-Year Plan, for example, the rate of the updating of equipment is increasing by 1.5-fold with an increase of the amount of national income by 18 percent.

It is legitimate to regard the proportion between the components of the "science--technology--production" system as a general economic proportion, since scientific and technical progress is not confined to the framework of any one enterprise or sector. The public ownership of the means of production and the planned nature of the development of the economy create such an environment, in which unlimited freedom opens up before scientific and technical progress. Under these conditions the unified scientific and technical policy by means of the maintenance of the optimum proportions in the "science--technology--production" system is called upon to perform the role of a powerful catalyst, an effective means of the combination in practice of the achievements of the scientific and technical revolution with the advantages of socialism.

Another most important proportion forms, strictly speaking, in the sphere of research and development. This is the ratio between basic and applied research.

From the middle of the 1950's to the middle of the 1960's the leading increase of applied research was observed in the developed countries of the world. Such a situation required a change in the distribution of the forces and assets, which were been channeled into the development of various subsystems of science. As is noted in the works of American economists, an overall decrease of the expenditures on basic research, which led to the total decrease for the country as a whole by 10 percent, was characteristic of the period of 1968-1975. From 1975 to 1979 an increase of basic research with an

average annual rate of 5 percent occurred. In 1980 an increase of the expenditures on basic research as compared with 1979 by 13 percent with an increase of the expenditures on applied research by 11 percent was expected.[6] According to other estimates, over a 10-year period (the 1970's) the amount of allocations for basic research in the United States increased by 9 percent.[7]

In our country, according to the available data, the proportion of the expenditures on basic research in 1967 came to 12.7 percent, and in the late 1970's to 14 percent.[8] The general demands on this proportion were characterized at the 25th CPSU Congress: "We are well aware that the high-water flow of scientific and technical progress will dry up, if basic research does not constantly feed it."[9] Consequently, we have the right to draw the conclusion that the proportions are formed through all the stages of the science-production cycle, starting with basic research and end with the assimilation of scientific developments in production. Disproportions lead to the formation of "bottlenecks," which impedes scientific and technical progress. It can be said that the "capacities" of basic science should create such a reserve, which would supply applied research and development with a continuous flow of ideas. In turn, the "capacities" of applied science should be matched with the possibilities of the assimilation of their results at the stage of development.

What is the criterion of the distribution of expenditures by stages of the science-production cycle? Obviously, it is possible to suggest that in case of the distribution of forces and assets within the science-production cycle the main reference point is the acceleration of the introduction of scientific and technical achievements in production and the assurance of the output of products, which in their indicators conform to the best modern examples. Special attention is directed to this in the decree of the CPSU Central Committee and the USSR Council of Ministers "On Measures on the Acceleration of Scientific and Technical Progress in the National Economy."[10]

Attempts at substantiating these proportions have been made in economic literature. Thus, for example, V. S. Sominskiy cites in the first approximation the following relationship

$$A_c=2.3A+0.6A+1.2A+0.8A+1.8A+A,$$

where A_c is the total capacity of the system of scientific and planning organizations of the scientific and technical complex, which is arbitrarily expressed in rubles; A is the capacity of the research organization; 2.3A is the capacity of the design organization; 1.2A is the capacity of the technological organization; 0.6A is the capacity of the planning organization; 0.8A is the capacity of the pilot base; 1.8A is the capacity of the scientific research subdivisions of the enterprises, which are assimilating the new equipment.[11]

The proposed model as a whole is of interest, especially under the conditions of the integration of science and production. Unfortunately, the author does not cite specific data which correspond to the actual state of things. And the very attempt to express (if only arbitrarily) in rubles the capacity of the science-production system evokes a number of doubts and remarks.

First, what is reduced to the value denominator? According to the generally accepted assumptions, by the production capacity they understand the maximum possible output of products during the year under the most favorable conditions. It is well known that the production program proceeds from the production capacity, strives for it, but practically never is equal to it. But the main thing is even not in this. Usually the production capacity is measured in physical terms or in conventional physical units. Even for production of a large range the capacity is determined with respect to each item. Here an attempt is made to determine the proportionality of the capacities of the different stages of the science-production cycle through value measurers, such an attempt can hardly yield success.

Second, the vehicle of a product, after all, also changes in conformity with advancement from stage to stage: the report, the plan, the prototype. The question naturally arises: How many reports and how many of what kind of reports it is necessary to provide with capacities for the development of their basis of prototypes? It is extremely difficult to answer this question by using only rubles. It seems that the solution of the problem is possible all the same not through value measurers, but through labor measurers, on the basis of a good standard base. This question, let us emphasize once again, is of enormous practical importance for the acceleration of scientific and technical progress.

The extension of the goal program planning of the development of science and technology is one of the organizational means of achieving the optimum proportionality of the science-production cycle. According to the decree of the CPSU Central Committee and the USSR Council of Ministers "On Measures on the Acceleration of Scientific and Technical Progress in the National Economy," starting with the 12th Five-Year Plan all-union, republic (interrepublic) and sectorial (intersectorial) scientific and technical programs, as well as scientific and technical programs of regions and territorial production complexes will be formulated and the basic assignments of these programs should be included in the five-year and annual plans.

The scientific and technical goal programs are a set of measures, which are coordinated with respect to resources, performers and times of operations and are aimed at the solution of a major problem of the development of science and technology, which is envisaged by the comprehensive program of scientific and technical progress and the basic directions of the economic and social development of the country for a 10-year period. At present more than 200 such programs on the solution of the most important problems of the development of science and technology are being implemented. However, here it should be recalled that the program does not replace the plan. The role of programs, in the words of Academician N. P. Fedorenko, is similar to a supplementary framework, which supports those parts of the edifice of the economy, which experience the greatest load, require special attention due to the technical novelty or social importance and promise an especially great effectiveness of investments owing to important changes in the structure of production.[12]

The programs are fundamentally linked with the territorial and sectorial plans and are the logical continuation and concrete rendering of the basic principles of socialist planning. From the point of view of the optimization of the proportions with respect to all the stages of the science-production cycle the scientific and technical goal programs have an enormous advantage, since they broaden the scope for the shifting of resources within the framework of the accomplishment of a strictly defined task, by subordinating everything to the main thing--the quickest fulfillment of the entire cycle of operations and the acceleration of the introduction in the practice of socialist management of the achievements of science and technology.

The law of the planned development of the national economy, being in effect at all the phases of the reproduction process, requires, in particular, the maintenance of the correspondence between manpower resources and the means of labor. Of course, the nature and the method of establishment of this correspondence are determined with allowance made for the peculiarities of one formation or another, as well as the sphere of production activity. As applied to the field of scientific and technical progress the forms of the manifestation of this proportion in many ways are connected with the fact that in science the proportion of living labor is significantly greater than in the sectors of physical production proper. The proportion of wages in the total estimate of the expenditures in the sphere of scientific research and experimental design work come to 40 to 60 percent (while in basic research it comes to up to 90 percent). The conclusion that the proportion between personal and substantial factors should also be formed accordingly, suggests itself. However, scientific activity requires the most modern equipment. Obsolete equipment will not make it possible to obtain a positive scientific result. From the point of view of provision with equipment science should lead production and should take in what is most advanced and most modern. Consequently, the increase of the technical equipment of scientific labor should lead the overall increase of the expenditures on research and development. The rate of the updating of equipment for scientific research should be significantly greater than in industry, and, hence, the proportion between personal and substantial (technical) factors in science should be changed in the direction of the increase of the expenditures on equipment. This process is also being traced at present. For example, the planned expenditures on wages at institutions of the USSR Academy of Sciences (excluding affiliates) from 1965 to 1975 increased by 138 percent, and for the purchase of instruments and equipment by 738 percent.[13] According to the data of 120 scientific research institutes and planning and design and technological organizations (PKTO's) of Leningrad the rate of increase of the capital-labor ratio also led the rate of increase of wages and the total amount of expenditures.

The trends of the ratios of the various factors of the functioning of science convincingly testify that already today it is necessary to be concerned about the construction of plants which produce equipment for research of the near future. And a delay here is fraught with great and undesirable consequences for the entire national economy. Consequently a set of measures, which are aimed at the acceleration of the construction and the technical equipment of pilot and experimental bases and works, is outlined in the decree of the CPSU Central Committee and the USSR Council of Ministers "On Measures on the

Acceleration of Scientific and Technical Progress in the National Economy." A carefully thought-out set of economic levers and stimuli, which is aimed at the efficient use of the material and technical base of science and the achievement of greater efficiency of the powerful technical potential, which it has, is also necessary.

Under the conditions of the improvement of the economic mechanism the proportion, which is forming between the sources of financing of research and development, is of great importance. In recent times in connection with the creation in the sectors of industry of unified funds for the development of science and technology (YeFRNT's) the proportion of the assets of enterprises in the financing of scientific research and experimental design work has increased. For the national economy as a whole it increased from 40.6 percent in 1965 to 61.4 percent in 1980, while in industry it has achieved nearly 93 percent of the total amount of financing.[14] Here it is necessary to bear in mind that such a trend is traced primarily in applied science, although academic institutes are also using extensively in practice direct economic contractual relations with enterprises. As a whole society is maintaining its scientific reserve at the appropriate level through state budget financing. And for the present there is no other way. A portion of the assets, which are redistributed through the state budget, is allocated for the support of the operation of academic institutes, which conduct primarily basic research, as well as for the financing of the most important sectorial and intersectorial themes, which are being carried out at sectorial scientific research institutes and planning and design and technological organizations. A significant portion of the development, which is being carried out by the higher school, is also financed through the state budget. As our studies on the basis of the data of a large group of scientific research institutes and planning and design and technological organizations of Leningrad showed, the ratio between state budget and economic contractual financing, which is equal to 3:2 for scientific research institutes and 1:3 for planning and design and technological organizations, should be recognized as optimal. The arguments in favor of such a proportion consist in the fact that the indicators of the efficiency of activity (the level of the most important themes, the proportion of introduced jobs, the anticipated economic impact and others) proved to be significantly higher at the institutes and planning and design and technological organizations, which have the indicated ratios in financing.[15]

But the creation in the sectors of unified funds for the development of science and technology should, of course, change this ratio. The point is that, strictly speaking, the indicated fund is both centralized and decentralized. It is centralized from the standpoint of the sector, since the unified fund for the development of science and technology is created by means of deductions from the profit of industrial enterprises at the level of ministries. It is decentralized owing to its sectorial, and not national economic, significance. In this sense centralization at the national economic level hardly differs in any way from state budget financing. And the conditions of the formation of the unified fund for the development of science and technology differ by sectors of industry. According to the data of 11 machine building ministries the proportion of the unified fund for the development of science and technology in the total amount of financing in 1980 came to 47.2 percent. The share of economic contractual assets proper, for

example, in the Ministry of Machine Building for Light and Food Industry and Household Appliances came to about 70 percent, in the Ministry of the Machine Tool and Tool Building Industry and the Ministry of Construction, Road and Municipal Machine Building--65 percent.[16] In our conviction, if we regard the unified fund for the development of science and technology and the receipts in accordance with economic contracts as a single source, the above-proposed proportion retains its significance. If they are formed into independent headings, it is necessary to adjust the ratio. Let us note that the amount of the unified funds for the development of science and technology in the sectors of industry is also increasing. Thus, for example, in 1980 in 16 industrial ministries 2,962,000,000 rubles (4 percent of the total profit of industry) were deducted for the unified funds for the development of science and technology, while in 1982 28 industrial ministries deducted for the unified funds for the development of science and technology 4,507,00,000 rubles (more than 5 percent of the profit).[17]

One of the forms of manifestation of international (interstate) economic proportions is patent and license trade and international scientific and technical cooperation. The international division of labor is the basis for this process. Within CEMA by the early 1980's more than 2,200 scientific research institutes, planning and design and technological organizations and higher educational institutions were successfully cooperating. More than 800 problems and themes were being elaborated by them on a multilateral basis.[18] On 1 August 1980, for example, more than 200 agreements on scientific and technical cooperation with countries of Western Europe were in effect.[19] The role of interstate economic proportions in the sphere of scientific and technical cooperation is increasing under the conditions of the implementation of the unified state scientific and technical policy. Society should determine correctly the amount of assets, which are necessary for the conducting of research and development within the country, and assets, which are being allocated for the purchase of patents and licenses abroad. The present scientific and technical level of production is based on the advanced achievements of science. The situation, when it is better to purchase abroad a license or patent than to begin from the start in one's own country the entire set of operations on the science-production cycle, is economically profitable. At times owing to a number of reasons such a means in principle is unacceptable and it is necessary to have one's own developments and one's own technology. It seems that there should be a special competent organ at the level of the USSR Academy of Sciences, the State Committee for Science and Technology and the State Planning Committee (something like an interdepartmental expert commission), which with allowance made for all the factors would specify the proportions in the distribution of assets.

Thus, proportionality in the sphere of scientific and technical progress acts as one of the decisive tools of the implementation of the unified scientific and technical policy of the socialist state. The proper maintenance and regulation of the proportions in this sphere are a guarantee of the quickest introduction in the national economy of the achievements of science and technology and the combination in practice of the achievements of the scientific and technical revolution with the advantages of socialism.

FOOTNOTES

1. "Vsesoyuznoye soveshchaniye nauchnykh rabotnikov v Kremle 12-14 iyunya 1961 g. (stenogrammy, materialy)" [The All-Union Conference of Scientists at the Kremlin on 12-14 June 1961 (Verbatim Reports, Materials)], Moscow, 1961, p 33.

2. See, for example, G. M. Dobrov, "Nauka o nauke" [The Science of Science], Kiev, 1970, pp 80-84; Yu. S. Meleshchenko, "Tekhnika i zakonomernosti yeye razvitiya" [Technology and the Laws of Its Development], Leningrad, 1970, pp 210-211.

3. See K. Marx, F. Engels, "Soch." [Works], 2d edition, Vol 26, Part I, p 279.

4. K. Marx, F. Engels, "Soch.," 2d edition, Vol 20, p 501.

5. K. Marx, F. Engels, "Soch.," 2d edition, Vol 39, p 174.

6. See "The National Structure of Scientific Resources in the United States," "Ekonomika promyshlennosti" [The Economics of Industry], 20 E, No 3, 1981, pp 18-19.

7. See "On the Financing of Scientific Research and Development in the United States," "Ekonomika promyshlennosti," 20 E, No 4, 1981, p 16.

8. See L. S. Glyazer, "The New Stage in Science," EKONOMIKA I ORGANIZATSIYA PROMYSHLENNOGO PROIZVODSTVA, No 4, 1971, pp 24-25; V. A. Pokrovskiy, "Uskoreniye nauchno-tekhnicheskogo progressa. Organizatsiya i metody" [The Acceleration of Scientific and Technical Progress. Organization and Methods], Moscow, 1983, p 49.

9. "Materialy XXV s"yezda KPSS" [Materials of the 25th CPSU Congress], Moscow, 1976, p 48.

10. See PRAVDA, 28 August 1983.

11. See "Puti povysheniya effektivnosti nauchnykh issledovaniy i proyektno-konstruktorskikh rabot" [Means of Increasing the Efficiency of Scientific Research and Planning and Design Operations], Leningrad, 1974, p 15.

12. See N. P. Fedorenko, "Problemy programmno-tselevogo planirovaniya i upravleniya. Tezisy doklada na Vsesoyuznoy konferentsii 'Programmno-tselevyye metody v planirovanii i upravlenii v svete resheniy XXV s"yezda KPSS'" [Problems of Goal Program Planning and Management. Heads of a Report at the All-Union Conference "Goal Program Methods in Planning and Management in Light of the Decisions of the 25th CPSU Congress"], Moscow, 1977, p 14.

13. See G. A. Lakhtin, Ye. I. Korepanov, "The Technical Base of Science," VESTNIK AN SSSR, No 8, 1977, pp 41-43.

14. See A. F. Ashanina, "The Financing of Scientific Research by Receipts in Accordance With Economic Contracts," FINANSY SSSR, No 10, 1981, pp 34-38.

15. For more detail on this see F. F. Rybakov, "On the Economic Analysis of the Activity of Sectorial Scientific and Technical Organizations (On the Basis of the Example of Scientific Research Institutes and Design Bureaus of Leningrad)," "Problemy deyatel'nosti uchenogo i nauchnykh kollektivov" [Problems of the Activity of the Scientist and Scientific Collectives], Leningrad, 1973, pp 390-395.

16. See FINANSY SSSR, No 10, 1981, pp 34-38.

17. See "Narodnoye khozyaystvo SSSR v 1980 godu" [The USSR National Economy in 1980], Moscow, 1981, pp 504-505; "Narodnoye khozyaystvo SSSR v 1982 godu" [The USSR National Economy in 1982], Moscow, 1983, pp 510-511.

18. See N. Berdennikov, "Science, Technology and the Cooperation of Nations," MEZHDUNARODNAYA ZHIZN', No 10, 1980, p 73.

19. Ibid., p 74.

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ORGANIZATION, PLANNING AND COORDINATION

DEVELOPMENT OF BIOLAR SCIENTIFIC PRODUCTION ASSOCIATION

Riga KOMMUNIST SOVETSKOY LATVII in Russian No 12, Dec 84 pp 44-49

[Interview with Vladimir Petrovich Zamakh, general director of the Biolar Scientific Production Association, by KOMMUNIST SOVETSKOY LATVII correspondent I. Krutova: "The Scientific Production Association: On the Path to the Optimum Solutions"; place and date not indicated]

[Text] One of the basic directions of the diverse activity of the CPSU is the policy of the utmost intensification of production on the basis of the maximum acceleration of scientific and technical progress. This is a decisive prerequisite of the further increase of the well-being of the Soviet people, this area lies today on the front line of the historical competition of the two political and social systems. Therefore it is clear that the further development of science and technology and the extensive introduction of the latest and most promising scientific and technical achievements are not only the most important economic, but also the foremost political task of the CPSU.

Appreciable steps forward on the path of scientific and technical progress have also been made in the Latvian SSR. This was discussed at the meeting of the republic party aktiv, which was held on 19 October of this year. The analysis of the state of affairs, as Chairman of the Latvian SSR Council of Ministers Yu. Ya. Ruben indicated in his report at the meeting, shows that the concern about the development of scientific and technical progress is yielding definite results. The successful fulfillment of many basic indicators of the State Plan of the Economic and Social Development of the Latvian SSR serves as confirmation of this. Thus, in 3 years of the current five-year plan 3 billion rubles more national income were produced than during the same period of the last five-year plan. Here the rate of increase of the national income is 4.5 percent greater than is envisaged by the current five-year plan. It is important that 94 percent of this increase was obtained by the increase of labor productivity. In 3 years of the five-

year plan it increased by 12 percent with a plan of 8.6 percent. The introduction in production in republic industry alone of means of automation and mechanization, as well as new labor-saving technology made it possible to free more than 19,000 people from manual labor.

Does this mean that the state of affairs with scientific and technical progress and the introduction of the latest achievements in practice is entirely satisfactory? Of course not.

First of all, it is necessary to speak about several trends which cannot but cause alarm. They were also discussed at the meeting of the aktiv. Thus, during the current five-year plan as compared with the two preceding ones for the national economy of the republic as a whole the growth rate of labor productivity has slowed, which has told especially appreciably in industry. The number of new types of machines and apparatus, instruments and equipment, which have been developed and assimilated in the republic, is decreasing, as a result of this the proportion of newly assimilated products in the total volume of their output is intolerably low. All this urgently requires of the republic party organization, scientists and production leaders the search for new, optimum solutions of the existing problems and a new economic approach, which is determined by the tasks of scientific and technical progress. Here it is extremely necessary to determine precisely the directions of the campaign for scientific and technical progress, on which attention and forces should first of all be concentrated.

Today scientific production associations (NPO's), as is known, are playing an important role in this. A sectorial technological scientific research institute, other scientific divisions, sectors and laboratories, as well as production subdivisions are members of such associations.

The basic task of scientific production associations is the utmost broadening and extension of the front of scientific research in this area and the quickest introduction in production, with the least expenditures, of the most promising things from it.

As V. P. Alekseyev, chief of the Department of Science, Technology and Foreign Relations of the Administration of Affairs of the Latvian SSR Council of Ministers, reported, six scientific production associations are now in operation in our republic: the Soyuzmorinzhgeologiya Association of the USSR Ministry of the Gas Industry, the Soyuzvodpolimer Association of the country's Ministry of Land Reclamation and Water Resources, the Gauya Association of the republic Ministry of the Wood Processing Industry, the Progress

Association of the Latvian SSR Ministry of Local Industry, the Silava Association of the Ministry of the Forestry and Timber Industry and the Biolar Association. Let us speak specially about the last two--it is proposed that starting in January 1985 they will operated under the conditions of an experiment, which has in view the changeover of both associations to the new system of planning and financing with respect to the sector "Science. Scientific Service." This work is being carried out in conformity with the provisions of the decree of the CPSU Central Committee and the USSR Council of Ministers "On Measures on the Acceleration of Scientific and Technical Progress in the National Economy."

Our correspondent I. Krutova ask to tell about how one of these formations--the Biolar Scientific Production Association--is operating today, about its successes, difficulties and prospects V. P. Zamakh, general director of this scientific production association.

[Question] Vladimir Petrovich, what is Biolar in general? What enterprises and institutions belong to it?

[Answer] Biolar (until recent it was known by the name Biokhimreaktiv) is a scientific production association which specializes in the development and production of biochemical reagents. Within it are three structural units: the All-Union Scientific Research Institute of Applied Biochemistry, the main organization of the association, the Olayne Plant of Chemical Reagents and the former Riga Reagent Plant, which is now called Works No 1.

So that the readers would get a clear idea of our association, it is necessary, in my opinion, to characterize if only briefly its structural subdivisions. I will begin with the institute. It includes about 20 scientific, analytical and technological laboratories and a number of other scientific subdivisions, carries out the coordination of all the activity of the association on the development of biochemical reagents and preparations, studies the present state of affairs in the sector and analyzes the prospects of its development--both in our country and abroad.

The institute works in close contact with more than 80 organizations of various types and cooperates with many institutions of the USSR Academy of Sciences and the academies of the union republics. Among them are the Institute of Medical and Biological Chemistry of the USSR Academy of Medical Sciences, the institutes of organic chemistry and biochemistry and physiology of microorganisms of the USSR Academy of Sciences, institutes of the Academy of Sciences of our republic--the institutes of microbiology and organic synthesis, and similar scientific institutions of the Ukraine, Belorussia and other republics.

Our institute is carrying out the development of individual types of reagents with the participation of scientific organizations of a number of CEMA member countries.

As for the Olayne Plant of Chemical Reagents, it performs the functions of the pilot base of the association for the production of biochemical preparations and reagents of complex organic synthesis. These products are used widely for the support of the scientific research work being performed in the country, primarily in such fields of it as genetic engineering and biotechnology, molecular biology and genetics, biochemistry and microbiology. Moreover, they are finding use in medicine, the food and light industry and agriculture. Our products are very diverse, 1,200 descriptions in all.

[Question] Your association was established at the very beginning of 1977, and it is already possible, probably, to summarize some preliminary results of its work. What has the experience of the past 8 years shown?

[Answer] First of all I want to say at in accordance with the results of scientific production activity Biolar has repeatedly won first-class places in the all-union socialist competition of the enterprises of the sector.

The plan assignments are being fulfilled by the association with respect to all the technical and economic indicators. During the years of the 11th Five-Year Plan an economic impact in the amount of nearly 14 million rubles has been obtained from the introduction of our scientific developments in production. We are constantly expanding the output of known chemical reagents and preparations and introducing in production new types of chemical reagents and preparations, many of which were previously imported.

It is best of all, probably, to turn to figures. And they are such: if we take, for example, the period from 1970 to 1976, when the Olayne Plant of Chemical Reagents and the scientific research institution existed separately, by themselves, during these 6 years 77 inventions were developed at the institute and were introduced at the plant, and the economic impact, which was obtained from this, was equal to 4,262,000 rubles. But now let us take the years, when the plant and institute worked together, within the scientific production association, and compare. The figures will be very eloquent: 194 inventions were developed and introduced, the economic impact came to 24,476,000 rubles. The time of the introduction of inventions in production was also shortened.

But, in spite all this, Biolar for the present still has enough problems.

[Question] Tell us, please, about them in more detail. Especially as they are, probably, characteristic not only of your association.

[Answer] Of course. In my opinion, all the scientific production associations of the republic, the country and the sector are faced with these problems. I will dwell only an a few of them, which, in my opinion, are most important. I will begin with the fact that approximately 50-70 new methods are developed annually at Biolar, while far fewer are introduced in production. Why? This is a difficult question, it includes an entire set of the most diverse problems, which for the present are still waiting for their cardinal solution. And first of all one should examine the organizational arrangement of scientific production associations. It is necessary, in my opinion, elaborate a new, more well-balanced, considered system of the

planning and economic stimulation of the activity of such associations. Strictly speaking, every depends on this: their normal operation, its end results, the increase of the interest of every worker in the quickest possible development and introduction of new methods and processing methods, in other words, the efficiency of the activity of the association as a scientific production complex. And it is necessary to begin, I believe, with the introduction in the practice of scientific production associations of a unified comprehensive plan of scientific production activity.

The point is that the system of the planning of the activity of scientific production associations, which exists today, takes inadequately into account the specific nature of their work, while this leads to the lengthening of the "research--production" cycle, the narrowing of the assortment and the increase of the cost of products. The range of the most important types of products being produced and the total amount of reagents being produced, the fulfillment of the plan of sales with allowance made for contractual deliveries and the increase of the production of consumer goods and the decrease of expenditures per ruble of commodity production are the basic indicators, in accordance with which the work of the association is evaluated. As we see, here there are no indicators of the contribution of associations to scientific and technical progress and the increase of the scientific and technical potential of the country. Frequently the planning of the individual stages of the indicated cycle is not connected, is not coordinated with respect to the periods and the anticipated results. Indicators, which are envisaged for exclusively production enterprises and associations, are used to the detriment of the development and introduction of scientific and technical innovations.

The system of the planning and evaluation of the activity of scientific production associations, which exists at present, is the mechanical combination of the indicators of the activity of the scientific research institute and the industrial enterprise, it actually does not reflect the functioning of the association as a unified whole.

The use as one of the basic indicators of the work of associations of the indicator of the growth rate of labor productivity is, in my opinion, very debatable. For our scientific research association was established first of all for the purpose of the constant development of new equipment, its testing and the regular updating of the assortment of products being produced, and all this requires the frequent changeover of production. It is clear that under these conditions it is difficult to expect the stable increase of labor productivity.

The ripe need for the changeover of scientific production associations to the new procedure of planning also stems, in my opinion, from several other factors--for example, the fact that the sources of the financing of the scientific and production activity of the association, which is accomplished today through various channels, should be unified. Moreover, at present there are no forms of accounting and statistical reporting, which are common to scientific production associations, various balances are drawn up for the scientific and production aspects of the activity of the association, so far a well-balanced, precise system of the salaries of the workers of the

association has not been developed. In other words, it is necessary to support the organizational unity of associations with economic unity.

And, what is still very important: the implementation of these measures should be supported without fail by the introduction at scientific production associations of the principles of complete cost accounting and by its extension.

[Question] But by what is this presently being checked?

[Answer] Mainly by the different nature of the forms of management, which are being used in the structural units of the association: whereas the majority of production subdivisions are already on cost accounting, the scientific organizations, which have been included in the scientific production association, are still just beginning to change over to a cost accounting basis.

In my opinion, the improvement of the system of economic stimulation should also play a significant role in the improvement of the activity of the association, since the one now in effect does not properly ensure an interest of all the structural units in the accomplishment of the common tasks which face the association as a whole. And here, apparently, the centralization and subsequent redistribution of the incentive funds of the scientific production association are necessary. The point is that at present each structural unit within the association has a separate incentive fund, which it disposes of at its own discretion, here the contribution of the subdivision to the common cause is not taken into account, which, of course, gives rise to a certain lack of personal responsibility in these matters. The creation of a unified fund would make the internal economic policy of the association more flexible and would make it possible to make the share, which is due to one unit or another, clearly dependent on its contribution to the economic impact which was obtained by the enterprises of the sector from the introduction of our developments. In other words, there would appear here the opportunity to encourage those who have made gains and to punish the laggards--on the scale of the association as a whole.

[Question] What are the prospects of the future development of the association?

[Answer] Since April of this year the scientific methods supervision of Biolar has been assigned to the Administration for the Development and Production of Chemical Reagents and Biochemical Preparations for Scientific Research of the USSR Academy of Sciences, while the coordination of its production activity has been assigned to the All-Union Association of the Chemical Reagents and Ultrapure Substances Industry, Soyuzreaktiv. The advantages of such a status of Biolar are obvious, they should, in my opinion, contribute substantially to the further increase of the level of all scientific production activity. In what is their essence? The rights of the association in the area of the development and production of biochemical reagents and preparations are being broadened, various additional benefits for the workers of the association are envisaged--the increase of leave time of the scientific associates and of the salary increments. But, in addition to

advantages, the new status of Biolar is also posing for us additional important tasks--it is necessary, for example, to determine a new structure of our main institute, to set up pilot production.

For the purpose of solving all these problems we have drawn up a draft of the Temporary Statute on the Procedure of Conducting the Economic Experiment, in which new, unified indicators of the planning and evaluation of the activity of the scientific production association, which reflect the end results of the work of the association as a whole and make it possible to evaluate objectively its contribution to the development of scientific and technical progress in the subsector of the production of chemical reagents, are outlined. In addition to everything else, work under the conditions of the experiment will enable Biolar to increase significantly the output of specialized products, to shorten by 1987 as compared with the base year of 1983 the "research--production" cycle with respect to technological regulations and production methods from 5 to 3 years and with respect to laboratory methods from 2.5 to 1.5 years, and to do this mainly by means of the more precise coordination of operations at all stages and will give our scientific production association the opportunity to speed up significantly the assimilation of the new technology of the production of biochemical reagents and preparations and to shorten the time of its development, introduction and transfer to enterprises and production associations for the organization of the series and mass production of products. In short, a great future lies before Biolar.

In his statements at the October (1984) Plenum and at the regular meeting of the Politburo of the CPSU Central Committee K. U. Chernenko stressed that in our times the extensive introduction of the achievements of science and technology in production is one of the most important factors which determine the effective development of society, that "the changeover of the economy to the path of intensification can be achieved only on the basis of scientific and technical progress."

The state of affairs in this area is arousing some anxiety, therefore, as K. U. Chernenko indicated, the question of the acceleration of scientific and technical progress will be a subject of close examination at the next CPSU Central Committee Plenum, in order to ensure a fundamental change in this vitally important direction, at which the State Plan of USSR Economic and Social Development for 1985 is also aimed.

The quickest introduction in production of the achievements of science and technology and the development of new, most promising processing methods are a complex problem, and the search for its optimum solution should be conducted in all directions: in the plan of cardinal organizational and economic measures, a new approach to questions of the ideological support of production. The tasks on the acceleration of scientific and technical progress should constantly be at the center of the closest attention of party

organizations, local soviets, ministries and departments, scientific and production organizations. Scientific production associations are also called upon to make a significant contribution to their accomplishment.

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CSO: 1814/51

BUDGET AND FINANCE

STIMULATION OF SCIENTIFIC, TECHNICAL PROGRESS IN NONFERROUS METALLURGY

Alma-Ata VESTNIK AKADEMII NAUK KAZAKHSKOY SSR in Russian No 11, Nov 84 pp 26-31

[Article by K. Kazhmuratov and P. K. Uspanov: "Some Ways of Improving the Stimulation of Scientific and Technical Progress"]

[Text] Under present conditions scientific and technical progress (NTP) is acting as an important prerequisite of the intensification of production processes. The choice of the optimum means of the development of the scientific and technical potential and the acceleration of the introduction of the results of scientific research and development in the national economy depend on this.

A number of measures on the improvement of the planning and management of scientific and technical progress, which are examined in unity with economic stimulation, are envisaged in the decree of the CPSU Central Committee and the USSR Council of Ministers "On Measures on the Acceleration of Scientific and Technical Progress in the National Economy."[1]

The changeover to a cost accounting system of the organization of operations on the development, assimilation and introduction of new equipment and the material interest of the participants in the development and assimilation of highly efficient equipment, technology and new materials are important means of the stimulation of scientific and technical progress.

In recent years definite experience in the stimulation of the development of science and technology has been gained in many sectors of the national economy. In this connection the changeover of associations, enterprises and organizations of agriculture, construction, transportation, communications, geology and material and technical supply to a cost accounting system of the organization of operations on the development, assimilation and introduction of new equipment is deemed necessary in 1985-1987. However, the analysis and generalization of the gained experience have shown several ways of improving the stimulation of scientific and technical progress.

In Kazakhstan the enterprises and organizations of nonferrous metallurgy of the republic were some of the first to be changed over to the new conditions of the cost accounting system of stimulation, as a result of which the

qualitative indicators of the production of nonferrous metals increased significantly. Thus, at present the introduction of new equipment and advanced processing methods and standards have ensured ferrous metallurgy a leading place in the republic in product quality among the other sectors of the national economy of Kazakhstan.

The quality of primary nonferrous metals--lead, zinc, copper, titanium, magnesium, antimonial lead, potassium fluorotantalum, ammonium perrhenate, electrolytic lanthanum, scandium oxide, alumina, as well as individual types of lead, zinc and copper concentrates and a number of other products--is at the level of the best domestic and foreign analogues, while with respect to individual indicators surpasses them.

The volume of output with the State Emblem of Quality (GZK) and its proportion in the total volume of production of output are constantly increasing. In 1982 as compared with 1976 the proportion of output with the State Emblem of Quality had increased by more than 10 percent (absolute) and at present comes to about 37 percent of all the output being produced by the sector, which is significantly greater than the indicator both for the republic and for the USSR Ministry of Nonferrous Metallurgy as a whole.

The financing of the expenditures on the development, introduction and assimilation of new equipment and advanced technology is one of the important components of the mechanism of the management of scientific and technical progress.

In our country the improvement of the financing of scientific and technical progress was carried out, first, by the creation in sectors of a unified fund for the development of science and technology (YeFRNT) and, second, by the organization of the financing of scientific and technical programs through the main developing organizations. The planning of the introduction of scientific and technical achievements on the basis of scientific and technical goal programs dictated their complete and extensive financing.

The creation of the unified fund signifies the transition from the several existing sources of financing to a unified source, and it conforms more to the very nature of the expenditures on science and technology. In case of this method extensive opportunities for the use of the standardized method of the planning of expenditures on science and the industrial assimilation of its achievements are afforded.

Thus, the improvement of the system of the financing of scientific and technical progress is being carried out in the direction of centralization, concentration, the special purpose of assets and program financing.

Deductions from the planned profit of scientific production and production associations (enterprises) according to the standard and, for especially important scientific research operations, assets of the state budget are the source of the formation of the unified fund. As a whole by means of the unified fund the planned and additional expenditures on scientific research, experimental design, technological and pilot (experimental) operations are financed; the planned and additional expenditures, which are connected with

the preparation and the assimilation of the production of new and modernized types of products, their testing at the users' and the introduction of new technological processes, are reimbursed; the one-time and additional expenditures on the increase of the quality, durability and reliability of the output being produced are covered; the increased expenditures of the first and, in individual cases (with the permission of the ministry), the second year of the series mass production of new or modernized products are offset. Moreover, by means of the unified fund credit is repaid and the interest on credits of the State Bank and the All-Union Bank for Financing Capital Investments is paid.

In this connection it should be emphasized that the compensatory function, that is, the recovery by the enterprise (association), first, of the expenditures on the preparation and assimilation of the production of new equipment and, second, of the increased costs of the first period of the series production of new items, is one of the most important and complicated functions of the unified fund.

The analysis of the positive aspects of the unified fund shows that its creation by means of the profit has a favorable effect on the product cost. At the same time specific shortcomings in the formation and expenditure of this fund are stressed in the scientific literature. Thus, it is indicated that the methods of forming the unified fund do not yet make it possible to use completely the available potential means for the stimulation of scientific and technical progress in case of the creation of the source itself. In this connection the principle of the transfer of a portion of the unified fund to a superior organ after the subtraction of the assets, which are left at the disposal of the association (enterprise), is recognized as incorrect. Such a procedure is not conducive of the increase of the interest of the performers in the timely and complete formation of the sectorial fund of the financing of scientific and technical progress.[2]

The absence of a unified approach is also observed in the use of the assets of the unified fund for the development of science and technology. The point is that some enterprises, which receive allocations from the unified fund, are in a difficult situation in the area of the introduction of scientific and technical results. In this connection the question of the advisability of dividing the unified fund into such independent funds as the fund for research and experimental design work and the fund for the introduction of new equipment directly at industrial enterprises merits attention. In the scientific literature it is indicated that the unified fund should include the following subfunds of financial support: scientific research; experimental design and technological developments; the introduction of new equipment; the introduction of inventions.[3]

The unified fund for the development of science and technology, which is deducted from the profit and is distributed by the ministry on the basis of the national economic importance, the complexity and the amount of work, is the basic source of the financing of expenditures on scientific research and the introduction of new equipment and technology in nonferrous metallurgy. This made it possible to concentrate assets on the most important directions of scientific and technical progress in the sector.

The annual amount of the assets, which have been deducted from the planned profit for the unified fund in recent years, came to about 16.5 million rubles. It should be noted that, in accordance with the decree of the CPSU Central Committee and the USSR Council of Ministers "On Improving Planning and Strengthening the Influence of the Economic Mechanism on Increasing Production Efficiency and Work Quality,"[4] the allocation of a portion of the profit to the unified fund should be carried out in accordance with the standard from the volume of sold output.

At present the norms of the expenditures of labor, the norms, which characterize the consumption of basic and auxiliary materials, fuel and electric power (objects of labor), and the norms of the use of tools of labor are the most developed. Thus, there are methods of the determination of the standards of specific capital investments, the time of the assimilation of the rated capacities and production facilities, which are being put into operation, the calculation of the norms of the expenditures of labor and others. Work is being performed extensively on the introduction of the standardized planning of the wage fund in the sectors of industry. In this connection the further development of the standardized method of the distribution of the profit: which is deducted for the state budget, which is placed at the disposal of a superior economic unit (ministry, industrial association), which is left at the disposal of the production association (enterprise), as well as which is allocated for the development of science and technology, that is, to the unified fund, is of great importance. However, such a standard so far has not been elaborated by the organs of the Ministry of Finance and its scientific research subdivisions, as a result of which at the enterprises of nonferrous metallurgy for the present it is not being implemented. What has been said, undoubtedly, is one of the ways of improving the stimulation of scientific and technical progress.

The decrees of the CPSU Central Committee and the USSR Council of Ministers "On Improving Planning and Strengthening the Influence of the Economic Mechanism on Increasing Production Efficiency and Work Quality" and "On Measures on the Acceleration of Scientific and Technical Progress in the National Economy" with allowance made for the present trends of economic growth formulated an entire set of economic stimuli of scientific and technical progress, including material incentives, in accordance with which a direct dependence between the amount of the impact and the amount of the incentive funds is created. The decree deemed it necessary to form at scientific research, planning and design and technological organizations material incentive funds, funds for sociocultural measures and housing construction and production development funds. Now up to 20 percent of the assets, which are intended for the creation of the incentive funds of an organization (the additional deductions for the material incentive fund of enterprises), are channeled into the centralized fund for the payment of bonuses for new equipment, while the remainder of the assets are broken down in the following manner: 60 percent to the material incentive fund and 40 percent to the fund for sociocultural measures and housing construction.

The stimulation of the workers of organizations and enterprises: for the performance of basic, theoretical and research work; for the development,

assimilation and introduction of new equipment, which should have, in addition to an economic impact, a social, technical and other types of impact; the increase by up to 25 percent of the amounts of the bonuses for the development, assimilation and introduction of new equipment, which should decrease the labor intensiveness of operations with difficult and harmful working conditions; the increase by 25 percent of the amounts of the incentive for the development, assimilation and introduction of new equipment, which is intended for export, is the basic directions of the use of the centralized fund.

In the approved statute on the procedure of the formation and use of economic stimulation funds at scientific research, design, planning and design and technological organizations, production associations and enterprises, which have been changed over to the cost accounting system of the organization of operations on the development, assimilation and introduction of new equipment on the basis of supply orders (contracts), it is indicated that when the operations are performed by several organizations and enterprises, the distribution of the total amount of assets, which are being deducted for them in accordance with established procedure for the funds of the organizations and enterprises which are participating in the operations, is carried out among them in conformity with the proportionate participation, which is determined subject to the amount, complexity and type of operations being performed in the following amounts: for research and planning and design operations--within the range of 20-40 percent, for technological operations and operations on the preparation of production--20-40 percent and for the assimilation and the organization of the production of new equipment--30-50 percent.[5]

Until recently at scientific research and planning and design organizations the estimated cost or the wage fund (the amount of the deductions is from 4 to 10 percent) and at enterprises of industry the product cost (from 0.3 to 1 percent) were the source of the formation of the bonus fund for the development of science and technology. From this fund under the conditions of production collectives 50-70 percent and under the conditions of scientific collectives up to 50 percent of the assets were transferred to superior organizations for the formation of the centralized fund. The remainder of the assets were used by the organizations (institutions) and enterprises (associations) themselves.

The deductions from the profit and a portion of the profit from the incentive price markups, as well as the assets, which are included in the estimated cost of scientific research, experimental design and planning and technological developments, are the basic sources of the formation of the material incentive fund.

Thus, researchers[6] are unanimous that the formation of incentive assets by means of the profit, which was obtained by the actual decrease of the production cost, and the additional profit in the form of an incentive markup combines together the formation of a portion of the material incentive fund at enterprises and the incentive funds at scientific research, planning and design and technological organizations. In this case at associations (enterprises) and scientific and planning organizations the incentive funds

are formed by means of the introduction of some achievements or others of science and technology, which attests to the progressive nature of the prevailing system of the material stimulation of scientific and technical progress.

This mechanism guarantees, in essence, the cost accounting principle of the stimulation of scientific research and operations on new equipment, which conforms to the tasks posed by the party and government on the increase of the role of cost accounting in the activity of scientific research, planning and design organizations.

In the prevailing statutes and instructions and the procedural recommendations, which have been formulated by the ministry, on the use of the new system all the questions of planning, financing and economic stimulation are interconnected on the basis of their aim at the end result.

Prior to the changeover of the enterprises of the sector to the new system the stimulation of the workers of enterprises for the assimilation and introduction of equipment was carried out by means of deductions, which were envisaged in the plans, from the product cost in the amount of 0.3 percent of the wage fund of the industrial personnel engaged directly in production. Under the new conditions the material incentive fund for the introduction of equipment is mainly created by means of deductions from the profit, which is formed at the enterprises of the ministry as a result of the actual decrease of the product cost in case of the use of scientific and technical developments.

The analysis of the state of affairs on the payment of bonuses for the introduction of new equipment in the sector shows that this system for the most part is progressive, since the material stimulation of the workers of the enterprises and scientific organizations of the sector had been made directly dependent on the amount of the real impact obtained by the enterprise.

At the same time it is necessary to note that the new system has shortcomings and needs augmentation and specification.

First, the mechanism of the coordination of calculations and the determination of the amounts of bonuses with respect to coperformers have become unwieldy and require the drawing up and coordination of numerous documents. And as a consequence of this annually the financial plan on bonus assets for the introduction of new equipment is reported to the performers with a delay of 6 months as against the envisaged time, which is specified by the Model Statute on the Payment of Bonuses to Workers of Scientific Research, Design, Planning and Design and Technological Organizations, Production Associations and Enterprises, Which Have Been Changed Over to the New System of the Planning, Financing and Economic Stimulation of Operations on New Equipment, which was approved by the decree of the USSR State Committee for Labor and Social Problems and the All-Union Central Council of Trade Unions of 30 January 1978.[7]

Second, the amount of the standard (7 percent) of the deductions from the amount of the economic impact, which was established by the USSR Ministry of

Ferrous Metallurgy in 1982, is debatable, since the technical level and the novelty of the works being introduced are not taken into account here. This led to a decrease of the importance of the operations, which are included in the plan of new equipment, and, what is the most important thing, to the lack of consideration of the technical levels of the results being introduced. Moreover, among the developers of new equipment and advanced technology there is no interest in getting into the national economic plan of the republic or the sectorial plan of the ministry. As a result, many researchers are content with the fact that their recommendations are included in the plan of the introduction of new equipment of the enterprise. Naturally, such a plan is not checked in detail by organs of statistics and the ministry and, moreover, due to the lack of material, technical and financial resources it is frequently not fulfilled, which leads to the dragging out of the time of the implementation of recommendations which are of national economic importance.

How is such a situation to be corrected? In our opinion, a three-level standard of deductions for the material incentive fund should be established for the consideration of the novelty and as a whole the technical level of developments, as well as for the increase of the interest of workers in the implementation of the results of scientific research.

The measures and developments, which are patentable abroad, license developments, which are being introduced in production on the basis of purchased licenses, as well as recommendations, which contribute to the output of products with the State Emblem of Quality on the condition of their inclusion in the plan of state certification for the Emblem of Quality, should be assigned to the first level; research, which is performed at the level of invention, should be assigned to the second level, while all other recommendations, the implementation of which is carried out by the enterprise itself, should be assigned to the third level.

The ratio of the first, second and third levels of the standards of the deduction for the material incentive fund should be 1:0.7:0.5. Such an individualized approach to the stimulation of the developers of equipment and the workers of enterprises makes it possible to evaluate their labor subject to the conformity of the works being introduced to the world and the leading domestic level.

Thus, the improvement of the planning, management and economic stimulation of scientific and technical progress made it possible to obtain positive results in the science-production cycle. At the same time the more thorough study of the process of introducing the achievements of science and technology in production attests to the need for the improvement of its stimulation, which, undoubtedly, will raise to a higher level the mechanism of the management of scientific and technical progress.

FOOTNOTES

1. PRAVDA, 28 August 1983.

2. See "Sovershenstvovaniye khozyaystvennogo mekhanizma. Sbornik dokumentov" [The Improvement of the Economic Mechanism. A Collection of Documents], Moscow, 1980, p 175; "Tezisy nauchno-prakticheskogo simpoziuma. 1-3 iyulya 1981 g., sektsiya 2(3)" [Summaries of an Applied Science Symposium. 1-3 July 1981, Section 2(3)], Moscow, 1981, p 5.

3. K. Kedrova, "The Standardized Approach to the Financing of Scientific and Technical Progress," VOPROSY EKONOMIKI, No 10, 1977, p 138.

4. "Sovershenstvovaniye khozyaystvennogo mekhanizma," p 174.

5. "Sovershenstvovaniye khozyaystvennogo mekhanizma," p 169.

6. See A. M. Voronov, "Problemy nauchno-tekhnicheskogo progressa" [Problems of Scientific and Technical Progress], Moscow, 1980; V. Ye. Shalimov, "Khozraschetnyy mekhanizm upravleniya tekhnicheskim progressom na predpriyatii" [The Cost Accounting Mechanism of the Management of Technical Progress at the Enterprise], Moscow, 1980, and others.

7. NARODNOYE KHOZYAYSTVO KAZAKHSTANA, No 5, 1978, p 88.

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CSO: 1814/49

FACILITIES AND MANPOWER

FORECASTING OF PERSONNEL POTENTIAL OF SCIENCE

Moscow IZVESTIYA AKADEMII NAUK SSSR; SERIYA EKONOMICHESKAYA in Russian No 6, Nov-Dec 84 pp 27-40

[Article by L. E. Mindeli, S. A. Seyts and V. N. Shur: "On the Forecasting of the Personnel Potential of Science"; passages rendered in all capital letters printed in italics in source]

[Text] The article is devoted to the urgent problem of forecasting the most important component of the resource supply of science--the personnel of science. In it an analysis of the object of forecasting is made, its characteristic, specific traits are distinguished. Questions of the choice of a set of indicators, which are intended for the description of the personnel potential of science with allowance made for its peculiarities, are discussed. A mathematical model, which reflects the basic processes of the reproduction of personnel, is proposed for the elaboration of a forecast of the number of scientists and science teachers with allowance made for their skills structure.

The constantly increasing scale of scientific research, the formation of science in essence into a separate sector of the national economy, the steady trend toward the increase and intensification of its integration with the system of social production, as well as the significant influence on the social institutions of society are causing the urgent need for the prediction, the forecasting of the development of the scientific potential and its individual components, for the assurance of the union of the forecasts being elaborated with the overall system of national economic forecasting and inclusion in this system as a fundamental component.

It should be taken into account, however, that the start of systematic scientific and technical forecasts dates to approximately the middle of this century, and although by now its basic methodological principles have been formulated, particularly in works [1, 2], the used methods of forecasting are still far from perfection.

The task of the elaboration of sound forecasts in any area and the development of the personnel potential of science in particular to a significant extent is dictated by the degree of study of the characteristic, specific traits of the object of forecasting, the adequacy of the used conceptual system and corresponding statistical measurers, the goal and functions of the forecasts being elaborated.

Significant experience in forecasting the development of the scientific potential and the personnel potential was gained when formulating the Comprehensive Program of USSR Scientific and Technical Progress. At the same time a number of problems, which so far have not found a satisfactory solution, were identified.

The Specific Nature of the Personnel Potential of Science as an Object of Forecasting. A special place among all the resource components of the scientific potential belongs to scientific personnel as the basic productive force of science. The specific nature of the "production" of knowledge consists first of all in the creative nature of the labor of researchers, the unordinary character of scientific personnel and the uniqueness of the thought process. The "personal factor," which is responsible for a certain stochasticity of the processes of obtaining scientific results, plays an essential role in scientific knowledge. At the macrolevel the personal factor finds its reflection in the demographic (sex-age) and occupational skills structure, the different types of mobility of scientific personnel, their breakdown by types of research of organizations and and so forth. At the microlevel (the level of individual organizations) the need arises for the consideration of the psychological aspects of the activity of workers, the solution of the organizational problems of the formation of collectives and others. The second characteristic feature of the forecasting of the personnel potential of science consists in the fact that the present level of scientific research requires the supply of scientists with the appropriate material and technical base, skilled auxiliary personnel and the necessary information. Here in a large number of directions of scientific research the complete or partial lack of the necessary experimental base (instruments, equipment, devices) leads to the impossibility of performing work or at least to its significant slowing.

Thus, the problems of forecasting the development of the personnel potential of science should be solved in combination with the questions of the development of the other components of the scientific potential.

When implementing the principle of the active nature of forecasting the development of the personnel potential of science it is necessary to take into account, on the one hand, the needs of the national economy for the development of some scientific directions or others with the observance of proportionate interrelations between the individual types of research and, on the other, the possibilities of the state both in the supply of scientific labor with the necessary material and financial resources and in the reproduction of the required number of scientists themselves. The third peculiarity of forecasting the personnel of science consists in this.

From the last trait follows the fourth characteristic trait of the personnel potential of science--the dependence on the scale, forms and methods of the training and the increase of the skills of scientists and science teachers. It should be noted that the process of reproducing highly skilled scientists requires considerable time. Thus, the elaboration of forecasts of the number and structure of scientific personnel should be carried out in close interconnection with the forecasting of the development of all the units of the system of personnel training, and first of all higher education. Here it is necessary to take into account that the possibilities and quality of the training of both directly scientific personnel and specialists with a higher education in general are determined in many ways by the nature and degree of participation of leading scientists of the country in these processes.

With allowance made for the basic methodological principles of the forecasting of scientific and technical development and the specific peculiarities of the personnel potential of science as an object of forecasting let us examine the basic problems which arise at different stages of the elaboration of the forecast.

The System of Concepts and Indicators, Which Are Designed for the Characterization of the Personnel Potential of Science. The initial stage of forecasting consists in the study of the object of forecasting, that is, the internal structure and the nature of the interrelations with other components of the scientific potential, the sectors of the national economy and the system of the training and increase of the skills of scientific personnel, and in the analysis and selection of the indicators, which characterize most fully the processes of the functioning and development of the personnel potential of science.

At present the indicators of the number of those employed in the sector "Science and Scientific Service" and the number of scientists and science teachers are used for the most generalized estimation of the personnel potential of science. Although these indicators do reflect to a certain extent the scale of the development of scientific research, they do not give an idea about the qualitative composition of the scientific potential and should be supplemented by a large number of indicators, which can be united in the following groups.

THE FIRST GROUP OF INDICATORS characterizes the breakdown of the personnel component of the scientific potential in the national economy of the country. Among these indicators are: the breakdown of the scientific potential by sectors of science; the breakdown of the personnel of science by types of organizations; the breakdown of the personnel component of the scientific potential by sectors of the national economy; the regional structure of the personnel of science.

By the sectors of science there is usually understood academic science, science of higher educational institutions, sectorial science and plant science, that is, the research which is conducted at the scientific institutions of the USSR Academy of Sciences, at the sectorial academies of sciences and the academies of sciences of the union republics; the research which is organized on the basis of the scientific research divisions of

laboratories and other subdivisions of higher educational institutions; scientific research at sectorial institutes; scientific research and development at scientific production associations and research and planning and design subdivisions of enterprises.

The indicator of the breakdown of the personnel potential of science by types of organizations, which specifies the number of workers of the sphere of scientific research and experimental design work, who are employed at scientific research, planning and planning and design organizations, in teaching work at higher educational, secondary specialized and other institutions, in the management staff, at independent laboratories and other organizations, borders very closely on this indicator. The noted indicators, first, reflect the nature of the activity and the sphere of operation of the personnel of science and, second, to a certain extent make it possible to judge the breakdown of the personnel potential of science by types of research in the "basic research--applied research--development--introduction in production" cycle, which is especially important, since the statistical accounting of such a breakdown so far has not been organized.

The breakdown of the personnel component of the scientific potential by sectors of the national economy specifies the number of workers of science, who are employed at scientific organizations and institutions of various ministries and departments, which are grouped in accordance with the existing classifier with different sectors of the national economy. This indicator is important for the identification of the degree of supply of each sector with scientific research, which is, as is known, the basis of scientific and technical progress.

The regional structure of personnel specifies the number of those employed in science by individual republics, economic regions and so forth. This indicator characterizes the level of supply with the personnel scientific potential of individual regions of the country and the possibilities of their socioeconomic and cultural development.

THE SECOND GROUP OF INDICATORS reflects the internal structure of the personnel component of the scientific potential.

Among them are: the demographic structure of the personnel of science; the educational and skills structure of those employed in science; the functional structure of the personnel of science; the occupational structure of the personnel potential, that is, the breakdown of scientists by sectors of science and scientific specialties.

The demographic structure characterizes first of all the breakdown of the workers, who are employed in scientific research and experimental design work, by sex and by age groups. This indicator reflects to a significant degree the psychophysiological features of the body of a person, which can have an appreciable influence on the productivity of scientists and in the end on the efficiency of the functioning of science. The questions of the reinforcement of the personnel of science, the problems of the use of scientists of retirement age and others should be solved with allowance made for this indicator.

The breakdown of the workers employed in science by nationalities also pertains to the demographic structure. This indicator reflects the achievements in the area of social and cultural development, the international essence of our state and the results of the Leninist national policy of the party and the government.

The educational and skills structure of those employed in science characterizes the processes of the division of labor in science according to the difficulty of the jobs being perform, which require a specific level of knowledge, specialized training and experience.

First of all those employed in science can be divided into several groups in conformity with the received level of education and specialized training. At present there serves as attributes when assigning workers to one educational and skills group or another their having of an incomplete secondary education; a complete secondary education, a secondary specialized education, a higher education.

The awarding to workers of one "category" or another in conformity with the difficulty of the jobs being performed, in accordance with the existing "wage category scale" is also a reflection of the skills level of auxiliary personnel who do not have a specialized education.

The differentiation of scientists (they are usually formed from among people who have a higher education, although the attribute of a higher education, as was shown above, formally is not included in the existing definition of a ccientist, which is accepted in our country) according to the level of skills at present finds its reflection in the existing academic degrees and titles. Two academic degrees--candidate of sciences and doctor of sciences--and the academic titles of academician, corresponding member of an academy of sciences, professor, docent, senior scientific associate, junior scientific associate and assistant lecturer are awarded in the Soviet Union.

It is necessary to note that the indicator of the educational and skills level is to a significant extent of a qualitative nature and in many ways is determined by subjective appraisals and the personal qualities of the worker, while the existing attributes of the skills level reflect the present level of the measurement of this indicator.

The indicator of the functional structure of the personnel potential of science is closely associated with the skills structure of workers. The functional structure is determined by the Unified List of Positions of Workers and Employees, Who Are Employed in the USSR National Economy. Here the name of a number of positions of scientists and science teachers coincides with the name of academic titles, which reflect the skills structure of scientific personnel. For example, the concepts "junior scientific associate," "senior scientific associate," "docent" and "professor" are used for the designation of both the position and the academic title of a scientist.

In addition to the purely formal coincidence of the names a very close connection usually exists between the skills level of a scientist and the held

position, which, in particular, finds is reflection in the system of certification of scientific personnel. Thus, when determining and analyzing the skills level of scientists it seems advisable to use the entire set of presently available skills and functional attributes. At the same time, in our opinion, the need has arisen for the more precise definition and differentiation of the skills and functional attributes of those employed in science and especially of scientific personnel.

The division of labor according to the subject of research and the processes of the differentiation and integration of science find their reflection in the breakdown of those employed in science, and first of all scientists, by fields of the sciences and by scientific specialties, which determine the occupational structure of scientific personnel. At present the registration of scientific personnel is being carried out according to 19 fields of the sciences and more than 500 scientific specialties. Moreover, the existing occupational structure is not "frozen," established once and for all, but is improving in the process of the development of science itself. In the past two to three decades to a significant opposing, but at the same time "related" trends--the differentiation and integration of scientific knowledge--have been characteristic of the development of science. The former leads to the significant subject specialization of scientific personnel, the appearance of new, relatively "narrow" scientific directions and accordingly specialists who have a "narrow specialization." The latter trend consists in the increase of the role and proportion in scientific research of complex problems, which lie in a number of cases at the "junctions" of sciences, require for their solution the efforts of researchers of various specialties and lead to the universalization of the knowledge of scientists, the mastering by them of the methods of research in related sciences, that is, to the "broadening" of the specialization of specialists and the appearance in a certain sense of new specialties.

All the indicators examined above are absolute and are intended mainly for the characterization (description) in different contexts of the individual elements of the system of the personnel potential of science.

Relative indicators are usually used for the reflection of the internal interrelations between the individual elements of the system of the scientific potential and the dynamics of the development of the very "elements" and interrelations, for the characterization of the relations of the personnel subsystem with the other subsystems of the scientific potential, as well as with the "external environment," that is, the socioeconomic conditions of the development of the national economy of the country.

Among the most important ones of them are:

the proportion of scientists in the total number of those employed in science, including by sectors of science and types of scientific institutions, the fields of the sciences and scientific directions, which characterizes the support of the labor of researchers with auxiliary personnel;

the ratio between scientists and auxiliary personnel of various educational and skills groups;

the ratios in the breakdown of scientific personnel by types of research, which reflect the continuity in development over the chain "basic research--applied research--development";

the ratios between scientists by individual fields of the sciences and groups of scientific specialties;

the capital-labor, equipment-labor and instrument-labor ratios of the workers of science with allowance made for the specific structure of the capital, machines and instruments;

the electric power-worker and power-worker ratios of those employed in science;

the current and capital expenditures per employee in science and per scientist;

the information support of scientific research;

the proportion of those employed in science in the total size of the population and of those employed in the national economy, for example, the number of scientists per 100 and 1,000 people or 100 and 1,000 people employed in the national economy;

the proportion of scientists in the corresponding sector of the national economy in the total number of those employed in this sector;

the proportion of scientists in the total number of specialists with a higher education.

The first four groups of indicators reflect the internal structure and interrelations of the personnel subsystem of the scientific potential; the next four reflect the connection of the personnel subsystem with the other subsystems of the scientific potential and, finally, the last three groups of indicators reflect the relations of the personnel component of the scientific potential with the indicators of the development of the national economy.

Moreover, the rate of change of all the above-indicated absolute and relative indicators is used for the description of the dynamics of the development of personnel of science.

The indicators of the comparisons between countries, which determine the place of domestic science in the system of the world scientific potential, forms a separate group of indicators, which is designed for the analysis of the personnel potential of science.

It should also be indicated that at the lowest levels of disaggregation a significant place is assigned to the indicators, which characterize the practical and personal qualities of scientists and the organizational structure of scientific institutions.

The examined group of indicators should be taken into account when elaborating forecasts of the personnel component of science and find reflection in the proposed methods of forecasting. At the same time it should be taken into account that the study in different contexts of the structure of the personnel potential of science and the accomplishment of the tasks of the forecasting of the planning and management of the personnel of science become practicable only in the presence of the corresponding information support of the entire set of problems which arise in this area.

The second stage of the elaboration of the forecast consists in the evaluation and analysis of the present state and the basic trends of the development of the personnel of science.

The Characterization of the Present State and Several Trends of the Development of the Personnel Potential of Science. By the beginning of the 11th Five-Year Plan 4.4 million people, or about 4 percent of the total number of people employed in the national economy, were employed in the sector "Science and Scientific Service." The number of scientists and science teachers by the beginning of 1981 came to 1.4 million, of them 37,700 are doctors of sciences and 396,200 are candidates of sciences. Here the growth rate of the number of scientists in the past decade exceeded the rate of increase of workers and employees, who are employed in the national economy of the country.

In the past two five-year plans, however, a tendency for the growth rate of the number of scientists to slow was noted, which is connected with the transition from the primarily extensive stage of the development of science to the intensive stage.

At the same time as the increase of the total number of scientific personnel their qualitative composition is constantly changing due to the increase of the proportion of people who have academic degrees. It is possible to trace the dynamics of the change of the skills structure of scientific personnel for the period from 1965 to 1980 from the data cited in Table 1.

The analysis of the data cited in Table 1 shows that the above-noted tendency for the growth rate of the total number of scientists and science teachers to slow is also characteristic of the workers who have the academic degree of candidate and doctor of sciences. The indicated circumstance is connected, apparently, both with the increase of the demands on the quality of dissertation works and the complication of the nature of research and with the decrease of the influx of the young reinforcement into science. In particular, the graduating class of graduate students of resident studies decreased in 1980 as compared with 1975 from 15,600 to 11,800 and remained practically stable (at the 1980 level) in 1981 and 1982 (Table 2). A similar picture is also observed with respect to the total graduating class of graduate students of resident and correspondence studies. At the same time the total number of graduate students during the indicated period steadily increased. The noted tendency for the graduating class of graduate students to decrease with the increase of their total number, in our opinion, requires the special examination of the problem of the efficiency of individual forms of the training of skilled scientific personnel. Here we will direct

attention to the fact that when forecasting the development of the personnel potential of science it is necessary to take into account various aspects of the process of the reproduction of scientific personnel.

Table 1

Dynamics of the Skills Structure of Scientists and Science Teachers, Percent*

	1965	1970	1975	1980	Average annual growth rate 1966–1970	1971–1975	1976–1980
Scientists and science teachers, total	100	100	100	100	7.2	5.7	2.5
including those having an academic degree	22.4	26.2	29.3	31.5	10.6	8.1	4.1
of them							
doctors of sciences	2.2	2.5	2.7	2.8	9.8	7.1	3.2
candidates of sciences	20.2	23.7	26.6	28.7	10.7	8.2	4.2
those not having an academic degree	77.6	73.8	70.7	68.5	6.2	4.9	1.9

*Calculated according to the statistical yearbook "Narodnoye khozyaystvo SSSR v 1982 g." [The USSR National Economy in 1982], Moscow, Finansy i statistika, 1983, p 89.

Table 2

Number and Graduating Class of Graduate Students (at the end of the year, thousands)*

	1970	1975	1980	1981	1982
Total graduate students	99.4	95.7	96.8	97.9	98.3
of them those who studied:					
with leave from work	55.0	41.9	39.7	42.0	44.2
without leave from work	44.4	53.8	57.2	55.8	54.1
Total graduated during the year	25.8	26.0	23.8	23.6	24.2
of the number who studied:					
with leave from work	16.4	15.6	11.8	11.5	12.1
without leave from work	9.4	10.4	12.0	12.0	12.1

*"Narodnoye khozyaystvo SSSR v 1982 g.," Moscow, Statistika i finansy, 1983.

The indicators examined above, while characterizing the "scale" and qualitative content of the personnel potential of science, do not give a sufficiently adequate evaluation of it owing to the fact that when measuring them THERE ARE NOT TAKEN INTO ACCOUNT THE NATURE AND DEGREE OF PARTICIPATION of a number of categories of scientists and science teachers in directly research work. This is connected with the imperfection of the existing methodology of registering scientists and science teachers. On the one hand,

people, who at the given moment are not engaging in scientific research, but are performing economic administrative or production functions, are, in our opinion, unjustifiably included among them and, on the other, a number of categories of specialists, who are taking a direct part in scientific work, are not included among them. Thus, for example, all people, who have an academic degree or an academic title (professor, docent, senior scientific associate, junior scientific associate, assistant lecturer) regardless of the place and nature of the work being performed by them, are included among scientists and science teachers. At the same time there are not included among scientists technicians and laboratory assistants, who perform scientific work, but do not have a higher education, special students doing research and graduate students (although according to one to the requirements of the USSR Higher Certification Commission the themes of dissertation works should be directly linked with the plans of scientific research operations of the subdivisions, in which the dissertations are being completed), as well as people from among the auxiliary scientific personnel, who are enlisted for the performance of pilot and experimental operations.

In this connection for the obtaining of more accurate data it is necessary to supplement the examined indicators with such indicators which reflect the participation of scientists in the process of research. The breakdown of scientists by sectors of science and types of institutions and others are among such indicators. The data, which characterize the breakdown of personnel by the three basic sectors of science: the academic sector, the sectorial sector and the sector of higher educational institutions, are cited in Tables 3 and 4.[1] As is evident, the sectorial sector, in which more than half of all the scientists and science teachers are employed, is the largest. In the number of employees there then come the sector of higher educational institutions and, finally, the academic sector. Here over the past decade the nature of this breakdown has practically not changed.

Table 3

The Breakdown of Scientists and Science Teachers by Different Sectors of Science (at the end of the year, percent)

	1970	1975	1980	1981
All scientists and science teachers	100	100	100	100
of them those employed by sectors:				
academic	9.3	8.6	9.2	9.1
sectorial	53.1	56.4	54.8	55.0
of higher educational institutions	37.6	35.0	36.0	35.9

The sectorial sector of science, while holding first place in the total number of scientific personnel employed in it, at the same time is significantly inferior to the sector of higher educational institutions and the academic sector in the proportion of personnel of the highest skills--doctors and candidates of sciences. With respect to the proportion of personnel, who have the academic degree of doctor and candidate of sciences, in the total number of those employed in the corresponding sector the latter, that is, the sectors

of science, are broken down in the following manner: the academic sector, the sector of higher educational institutions, the sectorial sector. Thus, the problem of providing first of all the sectorial sector of science with highly skilled personnel arises. It should be taken into account, moreover, that not all the scientists and science teachers of each sector take a direct part in scientific research activity. A portion of the personnel, who are included in the number of scientists and science teachers of a specific sector of science, perform administrative and management functions both at the sectorial level and at the level of individual organizations. Thus, the estimates of the personnel potential of science with respect to each sector should be adjusted by 5-10 percent with allowance made for personnel of the indicated categories.

Table 4

The Breakdown of Scientists and Science Teachers, Who Have an Academic Degree, by Sectors of Science (at the end of the year, percent)

	1970	1975	1980	1981
All scientists and science teachers, who have the degree of doctor of sciences	100	100	100	100
of them those employed by sectors:				
academic	--	23.2	24.7	24.8
sectorial	50.7	28.5	27.5	
of higher educational institutions	49.3	48.3	47.8	75.2
All scientists and science teachers, who have the degree of candidate of sciences	100	100	100	100
of them those employed by sectors:				
academic	--	14.0	14.1	14.0
sectorial	50.5	39.1	38.6	
of higher educational institutions	49.5	46.9	47.3	86.0

Let us further note that when elaborating more detailed forecasts of the development of the personnel potential, as has already been indicated above, it is necessary to take into account another large number of absolute and relative indicators. First of all this applies to the occupational structure of scientific personnel and the supply with assets with allowance made for their specific structure and with current expenditures and auxiliary personnel with allowance made for the educational and skills structure of the latter. However, the lack or the incompleteness of the published statistical data makes difficult the evaluation of the development of the personnel potential with respect to these and other breakdowns. Thus, the information support of the tasks of forecasting the development of the personnel potential of science from the point of view of both the used conceptual system and the group of considered indicators needs improvement.

The third stage of forecasting consists in the choice or the elaboration on the basis of the data on the object of forecasting, which were obtained at preceding stages, of methods of realizing the forecast and making numerical calculations. Finally, the concluding, fourth stage includes the analysis of the obtained results, their interpretation and, in necessary cases, their adjustment. Further we will dwell on the methods of elaborating the forecast

of the personnel potential of science, since, in our opinion, at the concluding stages of forecasting precisely the methods of realizing the forecast present the most difficult problem.

The Procedural Support of the Tasks of Forecasting the Personnel Potential of Science. Depending on the level and goals of the forecasts being elaborated in case of their realization at present they are using a very wide range of methods, which include extrapolation and correlation regression methods, methods of expert appraisals, analytical and simulation models and others. In spite of the diversity of the existing methods, it is possible to unite them into two large groups, which reflect two universal approaches--the genetic and the standard approaches.

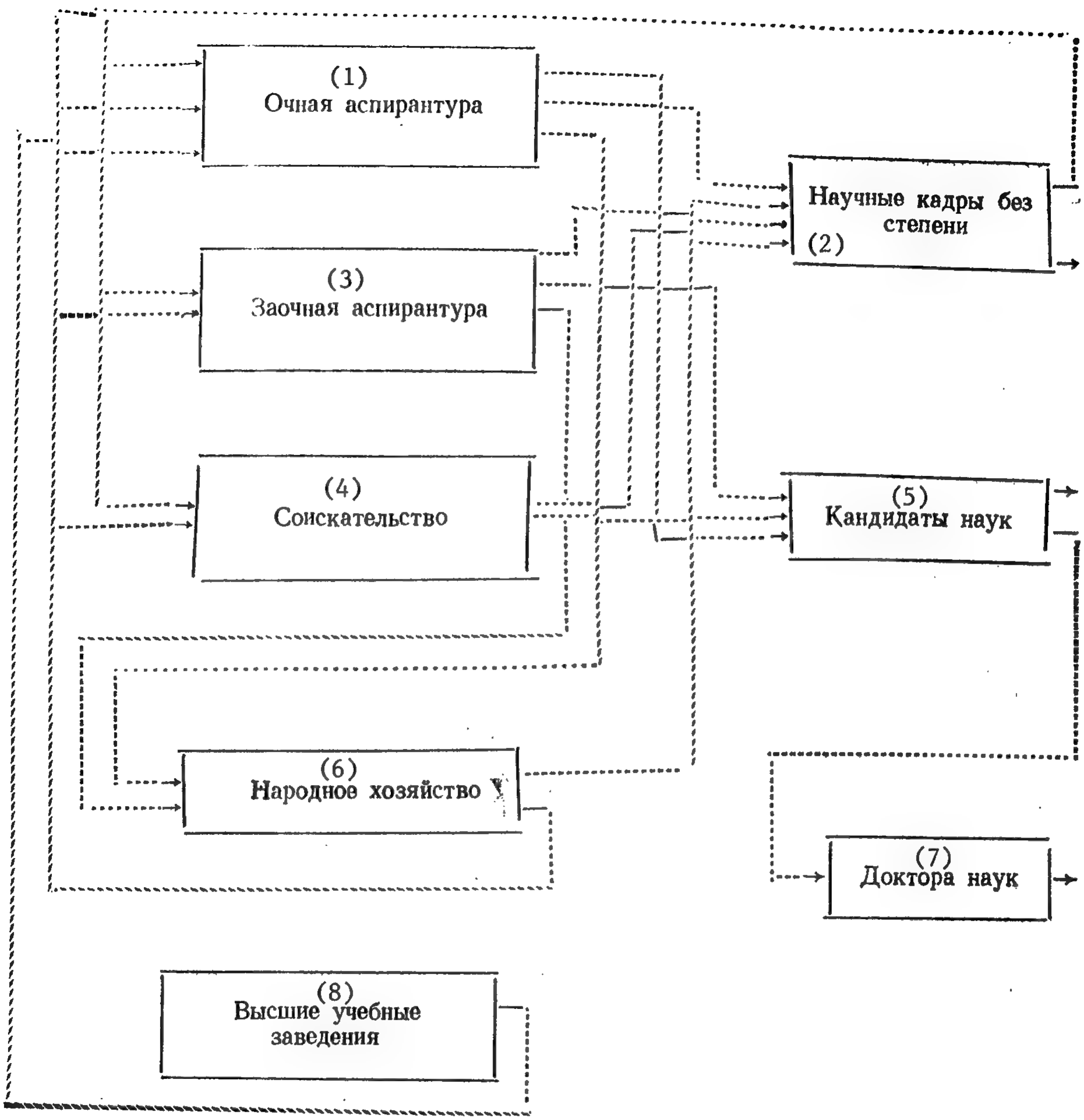
The essence of the genetic approach, given all the diversity of the methods used within it, consists in the carrying over to the future, that is, to the forecast period, of the present (or past) stable laws and trends. The validity of the use of the genetic approach follows from a certain inertia of practically all economic processes. However, a careful check for the observance of the stability of the conditions, under which this process will occur, is necessary when choosing the forecast period.

The recording of a specific goal (or set of goals) of the development of the process being forecast, as well as the determination of the possible (or one) trajectories of the transition from the formed state to the desired state constitute the basis of the standard, goal approach (diagram). Here the careful analysis and substantiation of such an approach first of all in the resource plan are necessary.

When implementing the former approach extrapolation methods are used for forecasting the development of the personnel potential, when implementing the latter approach correlation regression methods are used. However, in our opinion, both the former and the latter so far have not provided a satisfactory solution of the problem. The former owing to the "automatic nature" of the carrying over to the future of the formed, at times unfavorable trends, which characterize the extensive stage of the development of science, and the lack of the recording of control actions. The latter first of all due to the difficulties of the finding and correct substantiation of the cause-effect relations between the indicators of the development of the personnel potential of science and the indicators, which characterize the demands on science on the part of the national economy, as well as the restrictions which are imposed by the level of development of the other components of the scientific potential. Here, so it seems to us, difficulties of a mathematical nature (multicollinearity, the poor conditionality of the regression matrices and so forth) play a secondary role.

A model, within which the basic processes of the reproduction and functioning of scientific personnel of different skills groups (scientists, who do not have the academic degree of candidate of sciences and doctor of sciences) are joined into a unified system, is proposed for the purposes of forecasting the development of the personnel potential of science. Let us note at once that the authors see the possibility of using this model for the purposes of forecasting in two versions.

Diagram



Key:

1. Resident graduate studies
2. Scientific personnel without a degree
3. Correspondence graduate studies
4. Pursuit of a degree
5. Candidates of sciences
6. National economy
7. Doctors of sciences
8. Higher educational institutions

In the first version all the parameters (coefficients) of the model are taken to be constant and are determined on the basis of the available statistical data for one retrospective segment or another. In this case when using the model for the purposes of forecasting it actually proves to be close to the extrapolation methods. However, and we support this, IN CONTRAST TO THE METHODS OF DIRECT EXTRAPOLATION of tendencies or trends here SYSTEMS EXTRAPOLATION OCCURS, that is, extrapolation which is based on the formalized description of the processes of the functioning of the personnel potential of science.

In the second version the parameters of the model are time functions. The type of functions is chosen with allowance made for the restrictions, which are imposed by the level of development of the other components of the scientific potential (first of all the amounts of financing and the material and technical base), as well as on the basis of the overall goals of the socioeconomic and scientific and technical development of the country.

The schematic description of the now formed system of the reproduction of scientific personnel (the diagram) is the basis for the elaborated model. The higher educational system, various sectors of the national economy, resident and correspondence graduate studies, as well as the pursuit of a degree are regarded as the basic sources of the supplementing of the number of scientists.

Three basic skills levels of scientific personnel--scientists, who do not have an academic degree, candidates of sciences and doctors of sciences--are singled out in the diagram. The supplementing of the number of scientists without an academic degree is accomplished by means of graduates of higher educational institutions and specialists with a higher education, who are employed in various sectors of the national economy, as well as are studying in graduate studies, but are not preparing dissertations. The training of candidates of sciences is carried out on the basis of instruction in resident and correspondence graduate studies and through the pursuit of a degree. Finally, the supplementing of the number of doctors of sciences takes place by means of candidates of sciences, who have defended doctoral dissertations.

Along with the supplementing of the number of scientific personnel of all the groups in question the leaving of scientists, first, for natural reasons (retirement, disability, death and so forth) and, second, as a result of transferring to a job at organizations and enterprises of various sectors of the national economy, which do not conduct scientific research and development, is taken into account in the diagram. Here it is necessary to note the following two characteristic circumstances.

First, according to the existing method of the registration of scientists and science teachers, all people, who have an academic degree, are included among scientific personnel actually without regard for the place of their work and the nature of activity. As a result the measurement of the latter of the above-indicated flows, which characterizes the leaving of specialists of the sphere of scientific activity, at the level of the national economy is supported with information for the most part only with respect to scientists without an academic degree. In our opinion, the noted shortcoming of the

statistical registration of scientists can have an appreciable influence both on the adequacy of the description of the processes of the reproduction of scientific personnel and on the accuracy of the estimation of the personnel potential of science.

Second, a portion of the processes of the reproduction of scientific personnel involves not the change of their total number due to the influx from outside and leaving, but the change of the internal structure of the system of scientific personnel. In particular, the defense by candidates of sciences of doctoral dissertations leads to a certain redistribution between the number of doctors and candidates of sciences, without changing their total number. A similar remark is justifiable with respect to scientists without an academic degree, who are preparing candidate dissertations in correspondence graduate studies and through the pursuit of a degree.

With allowance made for the examined diagram of the description of the basic processes of the reproduction of scientific personnel of different skills groups and the remarks made above there is proposed a mathematical model of the balance of the movement of flows of scientific personnel in time, which is written as follows (in vector form):

$$dN(t)/dt=K(t)+L(t)+Q(t)+P(t)+G(t)+S(t)-E(t)-F(t)-H(t)-R(t), \qquad (1)$$

where $N(t)=\{N_1(t), N_2(t), N_3(t)\}$ is a vector, component i of which describes the number of scientific personnel of the corresponding skills group (here and below i=1 corresponds to scientists without an academic degree; i=2--candidates of sciences, i=3--doctors of sciences);

$K(t)=\{K_1(t), 0, 0\}$ is a vector, the components of which specify the size of the influx of graduates of higher educational institutions in scientific personnel at the moment of time (year) t;

$Q(t)=\{Q_1(t), Q_2(t), 0\}$, $P(t)=\{P_1(t), P_2(t), 0)$, $L(t)=\{L_1(t), L_2(t), 0\}$ are vectors, the components of which specify respectively the size of the influx into the system of scientific personnel of graduates of resident graduate studies and corresponding graduate studies and seekers of degrees in year t;

$G(t)=\{G_1(t), 0, 0\}$ is a vector with components, which are equal to the size of the influx into the system of scientific personnel of specialists with a higher education, who are employed in various sectors of the national economy, in year t;

$S(t)=\{0, 0, S_3(t)\}$ is a vector with components, which specify the number of scientists who defended doctoral dissertations in year t;

$E(t)=\{E_1(t), E_2(t), E_3(t)\}$ is a vector, the components of which describe the number of scientists of different skills groups, who for natural reasons are leaving the system of scientific personnel in year t;

$F(t)=\{F_1(t), 0, 0\}$ is a vector with components, which are equal to the number of scientists who are being sent for training to resident graduate studies in year t;

$H(t)=\{H_1(t), H_2(t), H_3(t)\}$ is a vector, the components of which specify the number of scientific personnel who are leaving for organizations and enterprises of the national economy, which do not perform scientific work;

$R(t)=\{R_1(t), R_2(t), 0\}$ is a vector which specifies the number of scientists who transfer from one skills group to another in year t.

Let us note the following basic assumptions which were accepted when constructing the model. First, the model was recorded under the conditions of continuous time, which made it possible to use for the formalization of the processes being described the means of the theory of differential equations, which offers considerable conveniences for the study of a number of possible qualitative events and situations, which are characteristic of the processes of the reproduction of scientific personnel. Second, for the assurance of the possibility of solving the problems of the long-range forecasting of the number and structure of scientific personnel the need arises for the minimization of the number of exogenous variables which are included in the model. Here, as is shown below, the hypothesis of a linear relationship between the variables included in the right-hand member of equations (1) and the number of scientific personnel of the corresponding skills groups was accepted.

According to the diagram, the number of those accepted for graduate studies $Q^{BX}(t)$ is formed from a portion of the scientists, who do not have an academic degree, graduates of higher educational institutions and specialists with a higher education, who previously worked at a works $\tilde{F}(t)$ ($\tilde{F}(t)$ is a scalar value). The possibilities of the training of candidates of sciences (the scope of admission) in resident graduate studies, correspondence graduate studies and through the pursuit of a degree are determined by the available training base and first of all the availability of highly skilled managers. Then under the conditions of the accepted assumptions

$$Q^{BX}(t)=(0, \varkappa_2, \varkappa_3)N(t)= {}_2N_2(t)+ {}_3N_3(t), \tag{2}$$

where ${}_i$ are the parameters which characterize the "contribution" of candidates and doctors of sciences to the yraining of resident graduate students.

Let us represent the ratio, which specifies the relationship between the size of admission to resident graduate studies and the graduating class with allowance made for dropping out, in the form

$$Q(t)=(\omega_1, \omega_2, 0)Q^{BX}(t-\tau)=\Omega Q^{BX}(t-\tau), \tag{3}$$

where $\Omega=\{\omega_1, \omega_2, 0\}$ is a vector, the components of which specify the proportion of graduate students, who successfully completed training (prepared candidate dissertations) and who dropped out of graduate studies; τ is the time of training in graduate studies. Expression (3) with allowance made for (2) can be written as

$$Q(t)=\Omega\varkappa N(t-\tau). \tag{4}$$

In much the same way the influx of graduates of correspondence graduate studies and seekers of degrees, which is specified by the vectors P(t) and L(t), can be represented in the following form:

$$P(t)=U\nu N(t-\xi), \tag{5}$$
$$L(t)=V\mu N(t-\varepsilon), \tag{6}$$

where ξ is the time of training in correspondence graduate studies; ε is the time of the preparation of dissertations through the pursuit of a degree; U, V and ν, μ are vectors, the components of which have a meaning similar to the components of the vectors $\Re$ and $\varkappa$.

Further it is assumed that the number of doctoral dissertations being defended in year t is proportionate to the number of candidates of sciences in the year $t-\eta$ (where η is the average time of the preparation of a doctoral dissertation). Then

$$S(t)=\lambda N(t-\eta), \tag{7}$$

where $\lambda = \begin{Bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & \lambda_{32} & 0 \end{Bmatrix}$ is a matrix in which the only coefficient different from zero specifies the proportion of candidates of sciences, who are defending doctoral dissertations.

The magnitude of the flows of the leaving of scientists of all skills groups for "natural" reasons E(t) and in connection with a transfer to a job in different sectors of the national economy H(t) is presumed to be proportionate to the number of scientists of the corresponding skills groups in year t and is written by means of transformation operators in the following form:

$$E(t)=MN(t), \quad N(t)=CN(t). \tag{8}$$

The flow of the leaving of scientists without a degree for training in resident graduate studies, which is characterized by the vector $F(t)= F_1(t), 0, 0$, is determined on the basis of the following. The relative stability of the structure of those entering resident graduate studies makes it possible to record the ratio between the extent of the recruitment for it of scientists $F_1(t)$ and specialists, who are arriving from production, as well as graduates of higher educational institutions, that is,

$$\frac{F_1(t)}{\tilde{F}(t)} = \theta. \tag{9}$$

Then with allowance made for (2) the value of $F_1(t)$ is determined in the following manner:

$$F_1(t)=\omega_2 \frac{\theta}{1+\theta} \varkappa N(t). \tag{10}$$

Finally, the vector R(t), the components of which characterize the shifts of scientists from one skills group to another, as a result of training in correspondence graduate studies, the pursuit of a degree and the preparation by candidates of sciences of doctoral dissertations, with allowance made for the assumption about the fixed structure of those entering correspondence graduate studies and the pursuit of a degree can be expressed in terms of the vector N(t) in the following manner:

$$R(t)=\begin{pmatrix} R_1(t) \\ R_2(t) \\ 0 \end{pmatrix}= R'(t)+R''(t)+R'''(t)=\begin{pmatrix} R_1'(t) \\ 0 \\ 0 \end{pmatrix}+\begin{pmatrix} R_1''(t) \\ 0 \\ 0 \end{pmatrix}+\begin{pmatrix} 0 \\ R_2'''(t) \\ 0 \end{pmatrix}, \quad (11)$$

where $R_1'(t)$, $R_1''(t)$, $R_2'''(t)$ are vectors, which characterize accordingly the number of candidates of sciences, who are being trained in correspondence graduate studies; candidate dissertations through the pursuit of a degree; the number of doctoral dissertations being defended. With allowance made for the above-indicated assumption in much the same way as (9)

$$\begin{aligned} R_1'(t) &= \frac{U_2\zeta}{1+\zeta}\widetilde{L}N(t-\tau), \\ R_1''(t) &= \frac{V_2\varkappa}{1+\varkappa}\widetilde{M}N(t-\tau), \\ R_2'''(t) &= \lambda_{32}N_2(t-\chi). \end{aligned} \quad (12)$$

Equations (1) with allowance made for (2)-(12) can be written in the following form:

$$\frac{dN(t)}{dt}=K(t)+G(t)+\Omega\varkappa N(t)+U\nu N(t-\xi)+V\mu N(t-\varepsilon)+\Lambda N(t-\eta)-MN(t)-CN(t)-DN(t-\tau). \quad (13)$$

As follows from (13), the characteristic features of the obtained equations are: first, the minimum number of exogenous variables--K(t), G(t), all the remaining addends in the right-hand member of (13) depend on N(t); second, time lags for the arguments of the vector-functions Q(t) and P(t).

Calculations of the parameters, which are included in the indicated expressions, were made on the basis of the statistical data, which characterize the processes of the reproduction of scientific personnel in the USSR during the period from 1970 to 1982 for the purpose of checking hypotheses and assumptions (2)-(12), which were accepted when elaborating the model. The results of the calculations showed that the fluctuation of the parameters being studied was observed during the entire indicated period. At the same time over the period in question it is possible to distinguish intervals of the relative stability of the constants which are included in the model. In our opinion, the indicated circumstance is connected with the changes in policy in the area of the training of scientific personnel. Thus, the obtained equations with constant coefficients can be used only for quite rough calculations and the forecasting of the number and structure of scientific personnel for short intervals of time. For increasing the accuracy of the forecast for the

long-term future the parameters, which are included in equations (13), were presented in the form of time functions. The type of these functions is determined on the basis of the extrapolation of dynamic time series.

The possibility of using equations (13) for the control of the processes of the reproduction of scientific personnel should also be indicated. In this case the change of the parameters of the model is used as control actions. Moreover, the elaborated model is quite universal, that is, it can be used both at the level of the sectors of science and at the level of the sectors of science and the national economic sectors.

FOOTNOTE

1. The data cited in Tables 3 and 4 were taken from work [3].

BIBLIOGRAPHY

1. Anchishkin, A. I., "Prognozirovaniye rosta sotsialisticheskoy ekonomiki" [The Forecasting of the Growth of the Socialist Economy], Moscow, Ekonomika, 1973.

2. Anchishkin, A. I., "Nauchno-tekhnicheskiy progress i intensifikatsiya proizvodstva" [Scientific and Technical Progress and the Intensification of Production], Moscow, Politizdat, 1981.

3. Chemodanov, M. P., "Kontseptsii rosta nauki i faktor intensifikatsii" [Concepts of the Growth of Science and the Factor of Intensification], Novosibirsk, Nauka, 1982.

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CSO: 1814/42

AUTOMATION AND INFORMATION POLICY

COMPUTER NETWORKS, COMMUNICATIONS SYSTEMS

Tallinn SOVETSKAYA ESTONIYA in Russian 2 Oct 84 p 2

[Article by Candidate of Technical Sciences R. Tavast, chief of the Control Systems Sector of the Institute of Cybernetics of the Estonian SSR Academy of Sciences: "One Computer Is Good..."]

[Text] [One computer is good,] BUT A "COLLECTIVE" OF COMPUTERS IS BETTER: JUST LIKE A COLLECTIVE OF PEOPLE, IT CAN SOLVE PROBLEMS WHICH INDIVIDUALS ARE NOT CAPABLE OF. BUT ONLY ON THE CONDITION OF THE GOOD ORGANIZATION OF INTERACTION! [in boldface] Joint work here is based on the connection and exchange of information among the members of the collective.

The set of such interconnected computers is usually called a computer network--by analogy with telephone or telegraph networks. Just as in telephony, the subscribers of computer networks can be both thousands of kilometers from each other and in adjoining rooms. In the former case radio channels are usually used, for example, via communications satellites. In much the same way as local telephones within an enterprise, the closely interconnected computers of one computer center serve in everyday work. (Then they speak about LOCAL COMPUTER NETWORKS [in boldface]. The distance of the subscribers in this case does not exceed 1-2 km, the communications channels between computers are telephone or coaxial cables.)

But the analogy of computer networks with conventional telephone communications ends with this.

Computers receive and transmit information which has been coded in numerical form. And here unexpected technical possibilities are afforded, especially if there are many subscribers and great reliability of transmission in case of a large load is required. For this the report being transmitted is supplied with a target address and other official information, as in a telegram. A special computer sends the "telegram" to the addressee, verifies the correctness of delivery and in case of distortions requests a new telegram. Owing to the fast operation of the computer such a communications system can transmit hundreds of thousands of characters a second! Moreover, there is no need to have a separate communications line between each pair of "conversing" computers--they can be tied into one common line, in which they "hear" everything, but only the addressee receives the telegram. It is also

convenient to organize the receipt of telegrams by all the subscribers--the conference mode. Moreover, in this way it is also possible to transmit speech and television signals.

The use of local digital systems is diverse. Imagine, for example, an office or a design bureau, in which the people work each at their own "intercommunication device" with a computer (a display terminal). Any document is drawn up here not on paper, but by means of the keyboard directly on the screen and is sent via the system of digital communications to the necessary person in the necessary division. If some data--on production, the object, plans, standards and so on--are needed in the course of drawing up the document, help yourself: they are stored in various computers of this system and can be obtained instantaneously. It is possible to send the document to the archive--to the memory of a special computer, and it is possible, if necessary, to automatically print and copy it on paper for sending by mail.

Why do we speak in this case about a computer network, for mainly people behind screens are interacting? The fact is that these "personal" devices themselves, via which a person comes into contact with other subscribers of the network, contain microcomputers. Moreover, even the printer (which serves, as a rule, several terminals) is controlled by its own computer and is thereby also a subscriber of the network. (Just as are the already mentioned computers for the storage of archives, the retrieval and processing of information.)

In modern automated production various technological operations, which a special computer or robot controls instead of man, become subscribers of such a local network. For example, at a nuclear electric power plant tens or even hundreds of small computers control the processes, and it is necessary to coordinate their operation very precisely and reliably. The automatic interlocks in case of an emergency should operate without error in fractions of a second (and this presumes a complex pulse, the reception and processing of telegrams between the corresponding computers).

Or take machine building and apparatus making. A large increase of labor productivity is being achieved here today also by the coordinated actions of machine tools with programmed control, robot-manipulators and means of transportation and warehousing. In this example a versatile system of digital communication between the computers, which have been built into the robots, machine tools and conveyors themselves, is also the best technical solution.

The Control Systems Sector of the Institute of Cybernetics of the Estonian SSR Academy of Sciences directed attention to the problem of such versatile communications--in the form of local computer networks--back in 1978, when the developments in this area both in our country and abroad were only at the initial stage. At that time they did not yet serve as a practical means. On the practical level industry with its needs stimulated the work, while on the theoretical level the World Congress on Automatic Control in Helsinki, in which a delegation of associates of the institute participated, did. The problem proved to be exceptional diverse: it was necessary to develop a communications language, means of control of the movement of "telegrams,"

special microcomputers for communication with every subscriber and programs which support the exchange of information.

Graduates of Tallinn Polytechnical Institute: group supervisor Anti Ira and chief designer Vello Khanson, were in charge of the work. They elaborated a number of original designs of the communications system. By 1983 several versions of the system, which received the name KONET, had been developed. Special attention in it is devoted to reliability and the reaction speed. (The latest version makes it possible to use two cables, moreover, to switch automatically from the main to the reserve cable, while the transmission speed in them is equal to 1 million bits a second.)

The KONET experimental systems were developed on the basic of microcomputers produced by the Hungarian Videoton firm. Our institute already has business relations of long standing with this firm. Its computers have given an excellent account of themselves and are being used extensively in the USSR, including the Estonian SSR, at the Slantsekhim Production Association.

KONET was presented as the standard for the system of small computers (SM EVM) of the CEMA countries. Our institute's special design bureau of computer technology realized it for the development of local networks on the basis of the popular SM-1800 computer.

The Videoton firm after a careful analysis purchased from the institute a license of the system for production in Hungary: KONET withstood the competition with the best western communications systems. This is the first major international license contract of the Institute of Cybernetics. This summer work in accordance with the contract was performed in Budapest with the participation of our associates A. Vyarimyae and I. Lamp. Brigades of developers will go twice more to Hungary in the very near future, while specialists of Videoton come periodically for tests of KONET.

The preparation for the use of the KONET system in the automated control system of industry of our republic is also under way.

In the sector research is being conducted at the same time as this on the development of the next generation of means of digital communications--with the use of optical fiber lines. This new, rapidly developing technology is ideally suited for the development of computer networks. It is possible owing to it to increase the speed and performance in terms of error probability of transmission by tens of times, while the expenses will exceed only negligibly the cost of traditional communications lines.

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CSO: 1814/27

PATENTS AND INVENTIONS

USE OF PATENT SERVICE IN DEVELOPMENT OF NEW MACHINES

Moscow TRUD in Russian 21 Jun 84 p 2

[Article by TRUD correspondent Ye. Temchin with a commentary by Chairman of the USSR State Committee for Inventions and Discoveries I. S. Nayashkov: "The Patent Service"]

[Text] They gave the All-Union Scientific Research Institute of Commercial Machine Building the assignment to design a loading machine for a line for the packaging of potatoes and other vegetables. They made it, but then it turned out that this machine in productivity is one-fourth as good as the already known analogues and uses twofold more electric power, and the vegetables themselves come out of it damaged much more. A poor machine.

And here is another case. The Kirovograd Planning, Design and Technological Institute was also given an assignment to design a new machine for, it is true, different purposes--for tilling, planting, the application of fertilizers and the rolling of soil. This work was also performed. The machines, of course, are different in designs and purpose, but the latter is not simpler than the former, while the result is different. The result was a good machine, which is nearly 1.5-fold more productive than the best foreign analogues, the speed is also greater, it uses less than half as much energy and is one-third as heavy.

What did it turn out that way?

The original approach to these machines was different. In the former case, before issuing the assignment to the designers, no one conducted research, but what had been done in the world when designing such machines, what new technical solutions had been found, what had been invented by others?

With the latter machine everything was different. Here they began patent research back before the assignment was issued to the planners. In other words, the client in advance knew exactly the parameters of the best analogues at that moment. Of course, he gave his designers the assignment to exceed what had been achieved by others. They, in turn, tried from the very start to ascertain what technical ideas had been incorporated when designing the latest models. Of course, they themselves did not obtain all the information they

needed. Specialist-patent experts did this. As a result the machine contains seven inventions.

Does it turn out that the success of the matter depends exclusively on whether there was patent research? Of course not. There are also other reasons, but this one is invariably present in all cases. A new All-Union State Standard, which obliges the client to conduct patent research, was put into effect in January of this year. Hence, is the problem solved?

Unfortunately, it is not. You will not solve it by promulgating an All-Union State Standard, for everything depends on how what is recorded in this document is fulfilled. And although the All-Union State Standard is a law, it is possible to evade it.

Quite recently I spoke with a motor vehicle designer. I asked: How do they intend to fulfill this new All-Union State Standard? At the entire association there are no patent services which are capable of conducting research, and, to all appearances, no one is about to set them up. How will they now act?

"Do you not know how?" he was surprised. "We will issue in the ministry our own version of the All-Union State Standard--a ministry standard, while we will demonstrate to the State Committee for Standards that we cannot work in accordance with their conditions, since in the sector there are its own peculiarities. Who will venture to shut down the plants of the association just because it is not adhering to the conditions of the new All-Union State Standard? Time is needed for preparation, but for the present, as an exception, of course, they will allow us to work in the old way. Do you understand?" he winked at me cheerfully and cunningly.

Of course these "minor ruses" were not compatible with the prospects of the development of patent information services, about which Yu. V. Sipapin, chief of the Division of Information Retrieval Systems of the Poisk Scientific Production Association, told me with enthusiasm literally the day before. The point is that at the main organization of the committee--the Poisk Scientific Production Association--automated systems for the retrieval, processing and transportation of information on inventions, which have been made both in our country and abroad, are being developed today. The Poisk Scientific Production Association with the patent library has created an enormous array of information--about 18 million descriptions. The mighty flow of the most valuable information on new technical solutions, which have been found by inventors of the world, is a gold mine for the developers of new equipment. All this must be processed, translated into Russian, sorted, duplicated and, without losing time, turned over to those who need this information for work.

The first units of this all-union system, which does not have analogues in world practice, are already in operation, computers are already recording on magnetic tapes compact information on inventions and are processing it. In just a few minutes they are capable of transmitting it properly. Other computers, also in just a few minutes, "know how" in the flows of information to find precisely that information which the developer needs at the given moment. All this seemed excellent to me--genuine progress in information

matters! But in conclusion, already in the completely different tone, Yu. V, Sipapin said:

"Unfortunately, too much depends on the manager. The most splendid automated information system does not yield the anticipated impact, if wherever they develop new equipment there are no or are almost no patent and information services, which would assume all the work on the delivery to the developer of information which is useful to him. For if he is forced to obtain it himself, what is the purpose then of all these automated systems?"

Of course, it is a matter not only of the rapid delivery of information. Its analysis, the sifting out through a fine screen of the truly necessary from the insignificant, for which, alas, they also issue certificates of authorship in our country and patents abroad, are also important. Research, which would show the developer in what directions inventor's thought is moving and where it is possible to achieve the greatest success, is also necessary. Not machines, but people--analyst-patent experts and information workers, who have an aptitude for forecasting--should do this. But if at the enterprise or institute the entire patent and information service consists of one or two people, about what kind of serious work can it be a question? God grant that these people would help inventors to draw up applications and would free them from the correspondence which is connected with applications. May they have somewhere to work with automated systems!

"Very much depends on managers," it is correctly said. At the All-Union Scientific Research Institute of Electrothermal Equipment the patent service has 26 people In 1982 the staff members of the institute submitted 190 applications for inventions, certificates of authorship were issued for 85 of them (on the average for the country about half of the applications are rejected), 130 inventions, the economic impact from which came to 12 million rubles, were used in institute developments. During the same year 175 patent studies were made on the most important themes. As a result the amount of developments of the highest quality category comes to 42.7 percent, in the technical level half of the products are not inferior to the best world models, while with respect to several types even surpass them.

Things at the State Scientific Research Institute of Nonferrous Metals are also no worse. It is possible to continue this list, but there still are also opposite examples. Thus, recently the State Committee for Inventions and Discoveries checked the state of the patent service at the scientific and technical information center of the Ministry of Tractor and Agricultural Machine Building. On the day of the check there were nine people there, of whom it was planned to discharge six. But precisely this service should coordinate the activity of the patent subdivisions at all the scientific research institutes and design bureaus of the sector and should carry out the procedural supervision of all inventing activity. Given such an attitude of the executives of the ministry to the matter it is not surprising that patent services are not envisaged at all at the affiliates of the main Scientific Research Institute of Tractors. They "forgot" them when they formulated the structure of these subdivisions. Meanwhile more than 1,500 engineering and technical personnel--potential inventors--work at them. It is not easy for them to develop something new.

"Why do some managers understand the value of patent services and others do not?" I asked Yu. V. Sipapin. "Can it be that whoever does not understand has fallen behind the times and does not conform to the held position?"

"No one has posed the question that way," was the response. "I believe that everything is simpler. They lived and hope to live further without patent services."

I remembered the motor vehicle designer and his words concerning the ministry standard instead of the new All-Union State Standard.

The history of the development of science and technology is the history of great and small inventions--the movers of progress. And in this connection any underestimation of the importance of patent services, which help the developers of new equipment, is nothing but a hindrance of scientific and technical progress. The patent expert should, finally, take his own place in the national economy.

Comments of Chairman of the USSR State Committee for Inventions and Discoveries I. S. Nayashkov:

The acceleration of scientific and technical progress in our country is one of the constant concerns of the party. In the documents of the 26th CPSU Congress and in the decisions of the subsequent CPSU Central Committee plenums much attention was devoted to the tasks of the improvement of the quality of the industrial output being produced, the improvement of its technical level and questions of the development of new equipment. But it is impossible to develop truly new equipment without using highly efficient inventions.

Millions of inventors work in our country, the economic effectiveness from the implementation of their suggestions comes to billions of rubles. But individual organizational shortcomings are preventing the further increase of the effectiveness of inventing.

The article of Ye. Temchin is also devoted to several such problems. It is of considerable interest, since it acquaints us with the positive experience in the organization of inventing activity and shows the importance of its dissemination everywhere, as well as the role of this experience in the development of new highly efficient equipment and technology.

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CSO: 1814/29

AWARDING OF 1984 KOMOSOMOL PRIZES IN SCIENCE, TECHNOLOGY

Moscow KOMSOMOL'SKAYA PRAVDA in Russian 28 Oct 84 p 4

[Article: "On the Awarding of the 1984 Leninist Komsomol Prizes in the Area of Science and Technology"]

[Text] The Buro of the All-Union Komsomol Central Committee, having considered the representations of the Commission of the All-Union Komsomol Central Committee for Leninist Komsomol Prizes in Science and Technology, resolves to award to young scientists and specialists of the national economy the 1984 Leninist Komsomol Prizes:

1. Ramazan Akhmedovich Aliyev, Tat'yana Anatol'yevna Shutova, Nikolay Yevgen'yevich Zverev, Yuriy Bogdanovich Kirsta, candidates of biological sciences, Akhmukhamed Sakhatdurdyyevich Ibragimov, junior scientific associates of the Institute of Deserts of the Turkmen SSR Academy of Sciences, Tylla Agadzhanovna Babayeva, instructor of the Turkmen State University, Valeriy Viktorovich Nikolayev, senior scientific associate of the Turkmen Affiliate of the All-Union Scientific Research Institute of Karakul Sheep Breeding, candidates of geographical sciences, Il'ya Vasil'yevich Kobozev, senior scientific associate of the Moscow Agricultural Academy imeni K. A. Timiryazev, candidate of agricultural sciences--for the work "The Strengthening of the Fodder Base of Animal Husbandry on the Basis of the Efficient Use of Cultivated and Natural Pastures and Hay Fields in Different Regions of the Country."

2. Anatoliy Vasil'yevich Andreyev, assistant lecturer, Oleg Yur'yevich Tikhomirov, docent, candidates of physical mathematical sciences, associates of Moscow State University imeni M. V. Lomonosov--for the work "Mathematical Models of the Kinetics of Super-Radiation."

3. Khayrulla Kabilovich Aripov, assistant lecturer of the Tashkent Communications Electrical Engineering Institute, Ol'ga Mikhaylovna Fedorova, junior scientific associate of the State Optical Institute imeni S. I. Vavilov, candidates of physical mathematical sciences, Timur Sakhibovich Tabarov, senior engineer, candidate of physical mathematical sciences, Yuriy Mikhaylovich Zadiranov, Oleg Vladimirovich Sulima, Sergey Ivanovich Troshkov, junior scientific associates of the Leningrad Physical Technical Institute

imeni A. F. Ioffe of the USSR Academy of Sciences--for the work "The Development and Study of Highly Efficient Semiconductor Heterophotoconverters of Concentrated Radiation and Autonomous Modules of Solar Electric Power Plants Based on Them."

4. Yelena Dzhorzhevna Belyayeva, Nadezhda Mitrofanovna Popova, Lidiya Mikhaylovna Urazova, engineers, Yuriy Semenovich Gavrilov, Svetlana Nikitichna Ivanova, Tat'yana Aleksandrovna Marusheva, Vladimir Nikolayevich Myachin, Vyacheslav Nikolayevich Marushev, design engineers, staff members of the Kazan Computer Plant, Aleksandr Vladimirovich Lapitskiy, chief engineer of the Scientific Research Center of Computer Technology, Viktor Nikolayevich Kozlov, chief of a group of the Institute of Electronics and Computer Technology of the Latvian SSR Academy of Sciences--for the support of the automation of the process and the improvement of the characteristics of the batch processing mode and the making up of sets of models of the Unified System of Electronic Computers.

5. Sergey Fedorovich Beresten', junior scientific associate of the Institute of Molecular Biology of the USSR Academy of Sciences, Inna Il'inichna Gorshkova, Georgiy Aleksandrovich Nevinskiy, candidate of chemical sciences, junior scientific associates of the Institute of Organic Chemistry of the Siberian Department of the USSR Academy of Sciences, Igor' Artyushevich Madoyan, candidate of biological sciences, senior scientific associate of Yerevan State University, Nina Aleksandrovna Moor, junior scientific associate of Novosibirsk State University, Malik Kubanychbekovich Nurbekov, senior laboratory worker of the Institute of Biochemistry and Physiology of the Kirghiz SSR Academy of Sciences--for the work "The Extraribosome Stage of the Realization of the Genetic Code: A Structural-Functional Analysis of Amino Acyl-Transport RNA-Synthetase, Transport RNA and Their Interaction."

Vladimir Vasil'yevich Malakhov, chief of a laboratory of the Institute of Marine Biology of the Far Eastern Scientific Center of the USSR Academy of Sciences, doctor of biological sciences--for the work "The Structure, Embryonic Development and Phylogeny of Nemathelminthes."

6. Yevgeniy Borisovich Berik, junior scientific associate of the Institute of Physics of the Estonian SSR Academy of Sciences, Aleksandr Viktorovich Polyakov, optician of components of quantum instruments, Lev' Kirillovich Mikhaylov, chief of a sector, Sergey L'vovich Seregin, chief engineer, Yevgeniy Mikhaylovich Spitsyn, chief of a laboratory, Aleksandr Vasil'yevich Khromov, process engineer, Mukhamed Mametbiyevich Goshokov, chief engineer, Igor' Viktorovich Krasnov, junior scientific associate, associates of scientific research institutes, Nikolay Alekseyevich Nemkovich, candidate of physical mathematical sciences, Leonid Petrovich Runets, junior scientific associates of the Institute of Physics of the Belorussian SSR Academy of Sciences--for the development of adjustable lasers on the basis of organic compounds.

7. Sergey Vladimirovich Biryukov, senior scientific associate of the Radio Engineering Institute of the USSR Academy of Sciences, Aleksandr Vsevolodovich Gorchakov, junior scientific associate of the Institute of Semiconductor Physics of the Siberian Department of the USSR Academy of Sciences, Irina

Vasil'yevna Yermolayeva, senior scientific associate of the All-Union Scientific Research Institute of Systems Research of the USSR Academy of Sciences, Viktor Vladimirovich Krylov, junior scientific associate of Moscow State University imeni M. V. Lomonosov, Aleksandr Georgiyevich Kozorezov, Vladimir Vladimirovich Medved', Sergey Apollonovich Nikitov, junior scientific associates, Viktor Petrovich Plesskiy, senior scientific associate, associates of the Institute of Radio Engineering and Electronics of the USSR Academy of Sciences, candidates of physical mathematical sciences--for the work "Wave Phenomena in Complex Solid-State Structures and Their Use for the Development of New Instruments of Solid-State Electronics."

8. Aleksey Fedorovich Bunkin, senior scientific associate, Dmitriy Nikolayevich Kozlov, junior scientific associate, associates of the Institute of General Physics of the USSR Academy of Sciences, Sergey Mikhaylovich Gladkov, Igor' Leonidovich Shumay, Viktor Nikolayevich Zadkov, junior scientific associates of Moscow State University imeni M. V. Lomonosov, Sergey Geogiyevich Ivanov, junior scientific associate of the Institue of Geochemistry and Analytical Chemistry of the USSR Academy of Sciences, candidates of physical mathematical sciences, Valeriy Pavlovich Kozich, candidate of physical mathematical sciences, junior scientific associate, Vladimir Vladimirovich Kvach, graduate student, associates of the Institute of Physics of the Belorussian SSR Academy of Sciences--for the development of highly sensitive methods of the active laser spectroscopy of the Raman scattering of light and their use for the study of gases and liquids.

9. Nikita Eduardovich Vantsyan, Aleksey Mikhaylovich Borovikov, senior scientific associates, candidates of medical sciences, Yuriy Aleksandrovich Abramov, Sergey Pavlovich Kozlov, junior scientific associates, El'mera Rashitovna Khusainova, operating room nurse, associates of the All-Union Scientific Center of Surgery of the USSR Academy of Medical Sciences, Mikhail Grigor'yevich Divakov, assistant lecturer of the Vitebsk Medical Institute, candidate of medical sciences--for the work "Restorative Microsurgery in the Treatment of Injuries, Diseases and the Consequences of Damages of Extremities."

10. Sergey Aleksandrovich Vasil'yev, chief project engineer, Sof'ya Pavlovna Dmitriyeva, senior engineer, associates of the State Institute for the Planning of Foundations and Substructures, Mikhail Ezravich Slepak, junior scientific associate, Sergey, Mikhaylovich Tikhomirov, Valentin Mikhaylovich Kuprin, senior scientific associates, candidates of technical sciences, Mikhail Mikhaylovich Ivanov, Aleksandr Alekseyevich Chapayev, senior engineers, associates of the Scientific Research Institute of Foundations and Subsurface Structures, Anastasiya Nikolayevna Tseyeva, junior scientific associate of the Yakutsk Affiliate of the ZabaykalpromstroyNIIproyekt [not further identified]--for the work "The Improvement and the Introduction of Methods of the Calculation and Design Approaches of Foundations and Substructures on Permfrost Soils."

11. Anatoliy Ivanovich Gretchenko, Oleg Alekseyevich Zverev, Yelena Vladimirovna Ivankina, docents, Anatoliy Yur'yevich Yegorov, Anatoliy Yevgen'yevich Kopylov, Nikolay Alekseyevich Nesterov, senior instructors of the Moscow Institute of the National Economy imeni G. V. Plekhanov, Valeriy

Arkad'yevich Fedorov, senior instructor of the Chuvash State University, Andrey Georgiyevich Medvedev, assistant lecturer of the Leninigrad Institute of Engineering Economics imeni P. Togliatti, candidates of economic sciences--for a series of works on the problems of the planning of scientific and technical progress and the increase of the efficiency of management in industry.

12. Viktor Afanas'yevich Zagoruyko, candidate of technical sciences, senior scientific associate, Valentina Vasil'yevna Krechetova, chemical engineer, Dmitriy Petrovich Demin, junior scientific associate, associates of the Magarach All-Union Scientific Research Institute of Viniculture and Viticulture, Roman Vasil'yevich Sushko, candidate of chemical sciences, chief engineer, Ivan Fedorovich Mironyuk, chief of a laboratory, Vladimir Viktorovich Brey, candidate of chemical sciences, junior scientific associate, associates of the Institute of Physical Chemistry of the Ukrainian SSR Academy of Sciences, Natal'ya Alekseyevna Dmitruk, junior scientific associate of the Scientific Production Associate of the Brewing and Nonalcoholic Beverage Industry, Mikhail Yefimovich Khosh, senior process engineer of the Sevastopol Kachinskiy Sovkhoz-Plant, Sofiya Ivanovna Kin'kova, chief of a shop of the Kiev Production Association of the Wine Making Industry, Aydyn Isa ogly Guseynov, chief engineer of the Sovkhoz imeni B. Sardarov of the Azerbaijan SSR--for the work "The Development and Introduction of the Technology of the Intensive Production of Food Beverages on the Basis of the Use of a New Compound of Colloid Silica."

13. Vitaliy Yur'yevich Zakharov, assistant lecturer, Igor' Alekseyevich Shchuchkin, junior scientific associate, associates of Leningrad Polytechnical Institute imeni M. I. Kalinin, Rayvo Vyaynovich Touart, senior engineer of Tallinn Polytechnical Institute, candidates of technical sciences, Aleksandr Grigor'yevich Solov', chief of a shop, Aleksandr Petrovich Lonskiy, electrical fitter, staff members of the Pribaltiyskaya State Regional Electric Power Plant--for the study of highly ballasted low-grade solid fuels, the development and industrial assimilation of methods of their efficient combustion.

14. Vladimir Nikolayevich Zinkovskiy, Nikolay Gennadiyevich Fedorin, design engineers, Vadim Serafimovich Kosyak, Yuriy Vasil'yevich Yaroshenko, chief engineers, Galina Alekseyevna Lukoyanova, Vladimir Anatol'yevich Trushnikov, engineers, Aleksandr Aleksandrovich Lustin, operator, Anatoliy Anatol'yevich Mozgin, Sergey Yevgen'yevich Potapov, senior engineers, associates of scientific research institutes--for the development and introduction of the Elektronika NTsTM adaptive industrial robot with a microprocessor controlling computer system.

15. Igor' Vasil'yevich Isayev, senior scientific associate, Dmitriy Vasil'yevich Kochetkov, Konstantin Vladimirovich Rudakov, junior scientific associates, candidates of physical mathematical sciences, associates of the Computer Center of the USSR Academy of Sciences--for the work "Algebraic and Metric Structures in the Theory of Pattern Recognition."

16. Sergey Pavlovich Nikonov, senior scientific associate of the Institute of Atomic Energy imeni I. V. Kurchatov, Oganes Mkrtychevich Khachatryan,

assistant lecturer of Yerevan Polytechnical Institute, candidates of technical sciences, Mikhail Nikolayevich Osokin, deputy chief of a department of the All-Union Planning, Surveying and Scientific Research Institute of Hydraulic Projects, Vladimir Viktorovich Zemlyanukhin, chief of a laboratory, Pavel L'vovich Makarovskiy, assistant lecturer, associates of the Moscow Power Engineering Institute, Pavel Fedorovich Nevzorov, candidate of technical sciences, foreman, Petr Fedorovich Shesternev, brigade leader, Valeriy Pavlovich Usatenko, fitter-assembler, staff members of the Desnogorsk Installation Administration of the Tsentroenergomontazh Trust--for the scientific substantiation, design development and introduction of effective emergency cooling systems for the increase of the safety of nuclear electric power plants with RBMK and VVER reactors.

17. Valeriy Vasil'yevich Ovchinikov, chief of a laboratory, Vladimir Vladimirovich Lipatov, assisstant lecturer, associates of the Moscow Institute of Steel and Alloys, Aleksandr Gennadiyevich Nikolayev, junior scientific associate of the Institute of Metallurgy imeni A. A. Baykov of the USSR Academy of Sciences, candidates of technical sciences--for the development of the technology and the study of the processes of the obtaining of semiconductor and dielectric films from solutions and melts.

Oleg Ivkent'yevich Sleptsov, chief of a laboratory of the Institute of Physical Technical Problems of the North of the Yakutsk Affiliate of the Siberian Department of the USSR Academy of Sciences, candidate of technical sciences--for the study of the nature of the formation of cold cracks and the development of a technology of the welding of low-alloy steels at low temperatures.

18. Viktor Aleksandrovich Rozentsvet, chief of a sector, candidate of chemical sciences, Anatoliy Gennadiyevich Vasil'yev, chief of a plant, staff members of the Sterlitamak Pilot Industrial Petrochemical Plant, Il'dar Rasikhovich Mullagaliyev, Valeriy Grigor'yevich Kozlov, junior scientific associates, candidates of chemical sciences, Venera Galiyevna Martsina, Elimiya Arkad'yevna Litovskaya, junior scientific associates, associates of the Institute of Chemistry of the Bashkir Affiliate of the USSR Academy of Sciences, Aleksey Sergeyevich Loktev, junior scientific associate of the All-Union Scientific Research Institute of Organic Synthesis, Andrey Mikhaylovich Sakharov, junior scientific associate of the Institute of Chemical Physics of the USSR Academy of Sciences, Aleksey Georgiyevich Dedov, Aleksandr Anatol'yevich Yaroslavov, junior scientific associates of the Chemistry Faculty of Moscow State University imeni M. V. Lomonosov, candidates of chemical sciences--for the development of new highly efficient catalytic systems for the processes of polymerization, hydrogenation and oxidation.

19. Yuriy Nagmetovich Sayfutdinov, junior scientific associate of the All-Union Scientific Research and Planning Institute of the Mining of Nonferrous Metals, Sergey Yakovlevich Duz', Lyudmila Borisovna Gavrilina, junior scientific associates of the Institute of Problems of the Complex Utilization of Mineral Resources of the USSR Academy of Sciences, Alisher Altayevich Rakhimdzhanov, deputy chief of the Uzbekzoloto Production Association, Viktor Vladimirovich Karev, senior engineer, Ol'ga Georgiyevna Murzina, designer, Fedor Konstantinovich Ivachev, blacksmith, staff members of the Uralgormash

Scientific Production Association, Igor' Iosifovich Spodar', chief of a section, Abdurakhim Abdurakhmanovich Minovarov, fitter, Fayzidin Musubidinovich Mukhitdinov, drift miner, staff members of the Chadak Mine (the Uzbek SSR)--for the development and introduction of the technology of the working of steep veins with the use of a mechanized set of machines with monorail movement.

20. Lidiya Iosifovna Petropavlovskaya, candidate of historical sciences, docent of the Moscow Institute of Railway Transportation Engineers, Petr Timofeyevich Tron'ko, academician of the Ukrainian SSR Academy of Sciences, chief of a department of the Institute of History of the Ukrainian SSR Academy of Sciences, Yevgeniy Vasil'yevich Taranov, candidate of historical sciences, scientific secretary of the Institute of Party History of the Moscow City Committee and the Moscow Committee of the CPSU, an affiliate of the Institute of Marxism-Leninism attached to the CPSU Central Committee--for a series of works on the history of the All-Union Komosmol and the problems of the military patriotic and international education of young people.

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CSO: 1814/30

UKRAINIAN 'AUCTIONS' OF NEW TECHNOLOGICAL PROCESSES

Moscow TRUD in Russian 24 May 84 p 2

[Article by Full Member of the Ukrainian SSR Academy of Sciences V. Poturayev, chairman of the Pridneprovskiy Scientific Center of the Ukrainian SSR Academy of Sciences (Dnepropetrovsk): "Toward Technology of the Next Century"]

[Text] A spacious room. Several tables. On each is a plate with the name of a scientific research institute. At the tables are scientists of the academic institutes of the Ukraine. Face to face with them are specialists of industrial enterprises. There is an interested, animated discussion. The uninformed observer would not immediately understand what is going on.

An auction is under way. True, a slightly unusual one.

At present technological processes, equipment and instruments, which in many ways will determine the level of technology of the 21st century, are being developed at the laboratories, design bureaus and institutes of the Ukrainian SSR Academy of Sciences.

Unfortunately, the introduction of the achievements of science remains our bottleneck. Neither the pace nor the scale of this work can satisfy. Frequently noteworthy developments, which do not have analogues in world practice, do not find extensive practical application. The traditional path of something new into life: "the laboratory--pilot industrial production--practice" is too long. The average time of introduction, just as many years ago, is not less than a decade. Today, President of the Ukrainian SSR Academy of Sciences Academician B. Paton believes, in the arsenal of the academic scientific research institutes of the Ukraine there are more than 300 new processing methods. Developed, checked, efficient ones, which are ready for mass introduction in various sectors of the national economy.

Here are the conditions and factors, which led us to the idea of organizing among industrial enterprises a unique auction of new technological processes.

They began with a brief description of all 300 processing methods. Imagine a sheet of ordinary writing paper. Several columns. The name of the institute, the surname of the author of the development, a description of the processing method, the address of the enterprise which has introduced it.

Sets of descriptions were sent to the industrial enterprises of Kirovograd and Zaporozhye oblasts. In the letters they asked the technical supervisors to carefully examine and report, which of the processing methods the enterprise considers important, with which of the scientists the experienced specialists would like to meet. Having ascertained the wishes of industry, they reported them to the institutes. They set the day of the meeting.

In Zaporozhye they held it in October of last year. Representatives of 20 scientific research institutes from Kiev, Kharkov, Lvov and Nikolayev and specialists of enterprises of the oblast center, Melitopol and Berdyansk came to the meeting. They were to discuss 150 preliminary orders for the introduction of 70 scientific developments.

At the first stage the scientists and production workers discussed in detail the innovations and the possibility of their use under specific production conditions. If required, the scientist-developers went to the enterprises and acquainted themselves with their specific nature. Then followed a business trip of the plant workers to the scientific research institutes. As a rule, the meetings and trips concluded with contracts on joint work or scientific and technical cooperation.

What did this actually give the enterprises? Here a several specific examples.

The Zaporozhstal' Metallurgical Plant. Here technical information has been organized well. A mighty detachment of researchers works in the central plant laboratory. Many operations are performed at a high scientific level. It would seem that it is difficult to surprise the Zaporozhstal' workers. But they, too, found at the auction much of interest for themselves.

From what was offered by the Institute of Electric Welding imeni Paton they chose the technology of strain-hardening plasma spraying. By means of it the metallurgists hope to increase by several fold the durability and serviceability of equipment, on the repair of which they are now spending vast assets.

The Institute of Problems of Material Science will make available to the plant a new domestic abrasive paste for the polishing of stainless steel. For the present the state is purchasing this material for much money abroad. The Institute of Superhard Materials will supply cutting blades for the machining of the bells of chargers of blast furnaces. According to preliminary calculations, the new tool will increase the labor productivity of machine operators by five- to sixfold.

There are many such examples. At the Zaporozhye meeting alone 73 contracts on the introduction of processing methods, which were developed by academic scientific research institutes, were signed.

In Kirovograd Oblast a year ago only three enterprises had permanent relations with academic institutes. Today, following the June auction, there are 12. The Krasnaya Zvezda and Pishmash plants and the nickel plant have concluded

several contracts each. The advanced processing method, which the Institute of Electric Welding imeni Paton supplied to the Krasnaya Zvezda Plant, has already yielded the plant an increase of labor productivity and an increase of the quality of agricultural machinery.

Apparently, it is possible to speak about the first results of the auctions. The most important thing is: the industrial enterprises were convinced with their own eyes of the enormous possibilities of applied science. Thus, in Zaporozhye and Kirovograd the new Sprut-5 general-purpose adhesive, which was developed by the Scientific Research Institute of the Chemistry of High Molecular Compounds, interested very many people.

The Zaporozhye workers of the byproduct coke industry, for example, intend to use it for the repair of pipelines, metal components and refractory linings. Today these operations have to be performed by hand, under the conditions of a high temperature and dustiness.

They are placing great hopes in Sprut-5 at the Zaporozhtransformator Association. The production workers and scientists reached an agreement on joint research on the development of new insulation materials and methods of insulation. The goal of the work is to free thousands of workers from difficult and monotonous manual labor.

During such meetings the academic scientific research institutes learn better the needs of enterprises and see, in what directions efforts should be focused. For example, at the Zaporozhye auction the production workers suggested tens of themes for research. Their fulfillment will make it possible to develop new technological processes, which increase labor productivity and decrease the consumption of raw materials, energy and fuel.

At the Zaporozhye and Kirovograd auctions the leading enterprises, which have powerful engineering services and much experience in the introduction of the achievements of science and technology, displayed the greatest interest in new processing methods. But it is clear that the works of academic institutes are of no less importance for small and medium-sized enterprises, which, as a rule, are not distinguished by a high technical level.

We believe that large enterprises should become the promoters of achievements of science in their regions. For this it is necessary to formulate a statute on the base enterprise and the form of the contract on joint work with the scientific center on the promotion and introduction of what is new.

Unfortunately, people were convinced of the low efficiency of the territorial centers of scientific and technical information. In the entire Dnieper River region, for example, not one processing method, which was developed at a scientific research institute of the Ukrainian SSR Academy of Sciences, has been introduced on the initiative of the Zaporozhye Information Center.

Obviously, it makes sense to think about special cost accounting divisions of introduction attached to the academy's scientific centers. If they existed, we would know that there is not only information on new developments, but also the feedback of enterprises and institutes. This would be a step in the

direction of the development of an efficient and effective system of the selection and introduction of the best works and the orientation of scientific research institutes toward specific vital tasks.

It turned out that not all the academic organizations responded to our proposals. Several did not send representatives at all. Unskilled, uniformed people attended on behalf of others. They were not able to satisfy the curiosity of experienced workers. It seems that a system of the interest and responsibility of the executives of institutes and the immediate performers for the extensive use of the developed processing methods is needed.

We derived lessons from the past meetings. We took them into account when preparing the new auction, at which specialists of hundreds of industrial enterprises of Dnepropetrovsk Oblast will meet with representatives of academic science.

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CSO: 1814/27

INTERNATIONAL S&T RELATIONS

ACADEMICIAN PATON CALLS FOR MORE COOPERATION IN S&T

Moscow IZVESTIYA in Russian 13 Nov 84 p 3

[Article by twice Hero of Socialist Labor Academician B. Paton: "Contacts and Contracts"]

[Text] The key to success in science is generalization. It requires the accumulation and correlation with each other of a large number of facts. It is possible to construct hypotheses and to draw conclusions only on such a firm basis. It is well known that any, it would seem, most unexpected discovery of a scientist is always prepared by the lengthy research of his predecessors--researchers from various countries.

The Effects of Large Generalizations

The highest level of today's science has been ensured by the collective efforts of a large number of researchers. That is why no country is conducting (is capable of conducting!) work in all directions of science with identical success and intensity.

The extensive international exchange of information has become a part, to put it figuratively, of the "technology" of scientific research. Today the entire world community of scientists has been drawn into it. Such a broad spectrum of information increases the possibilities of each researcher and enables him to correlate his own achievements with the international level, not to invent a "bicycle" and not to stop at what has been achieved. That is why international cooperatives have become a natural form of the organization of science.

Many prominent scientists abroad are speaking about the need for the utmost broadening of scientific relations. In particular, F. Press, president of the U.S. National Academy of Sciences. He believes that the broadest international cooperation in the area of basic research is necessary. The scientists of different continents should be enlisted in it. The area of the scientific interests of F. Press is geophysics. It is easy to imagine its urgency in our times, when reports on underground shocks and earthquakes are being received substantially more often than the people of earth would like. It is extremely important to determine reliably the seismic zones and to predict earthquakes.

The natural zones of risk occur wherever the lithospheric plates come together. Their boundaries do not coincide with state boundaries and are independent of the political convictions of those who live on this territory. The earth is the common home of mankind. The international cooperation of scientists in the area of geophysics and seismology is also based on this.

Man depends quite strongly on the planet which gave rise to him. But today the earth and its very existence depend more and more on man. Unfortunately, the anthropogenic load on all natural systems in many regions of the planet in general exceeds its strength--the self-restorative potential of the ecological system. The real threat of irreversible changes, which are fraught with unpredictable consequences for life on earth, is arising. For everything, which is done at each individual geographical point, directly affects other ones, and not only neighboring ones, but also those which are located in different parts of the world.

Many of the ecological problems in principle cannot be solved within a narrow national framework. Moreover, the majority of countries are not capable of independently bearing the burden of the costs which are connected with the difficult tasks. But among them are such vitally important ones for everything living as the preservation of all the diversity of natural resources, including minerals, timber resources, the resources of clean fresh water, the prevention of the pollution of the atmosphere and the world ocean. The improvement of the ecological situation on our planet requires the combination of forces and assets on an international scale. First of all the scientific and technical potentials of the largest states.

Boycotts Are Useless

Our country is constantly expanding equal and mutually advantageous cooperation on the international arena. The prestige of Soviet science to no small degree is contributing to this.

I will cite examples, which are closest to me, of the international scientific exchange of the Ukrainian SSR Academy of Sciences, a large subdivision of united Soviet science. We are now conducting joint research with foreign scientific centers on 38 themes and are cooperating with scientists from 71 countries. Large international forums both in the area of the basic sciences and on the development of advanced processing methods are being held systematically.

The contacts of the Ukrainian SSR Academy of Sciences with scientific organizations of the socialist countries are being developed especially successfully. Results of great importance have been obtained in the process of such joint research. In particular, scientists of the institutes of physics and semiconductors of the Ukrainian SSR Academy of Sciences and their colleagues from the Zentralinstitut fuer Elektronenphysik of the GDR Academy of Sciences made a discovery in the area of semiconductor physics.

Such new organizational forms of cooperation as joint scientific production collectives are being developed. For example, the Soviet-Bulgarian scientific

production laboratories for robots, as well as for powder metallurgy and composite materials are actively working. On the Soviet side the Institute of Electric Welding imeni Ye. O. Paton and the Institute of Problems of Material Science are taking part in them.

Intensive scientific and technical cooperation has contributed to the fact that important positive changes have occurred in the development of the CEMA member countries. The community of the tasks and goals, which face science of the socialist countries, and the fruitful relations between them are objectively leading to the emergence of the largest integrated international research complex in the world.

I would like to dwell separately on the development of the cooperation of institutes of the academy with organizations and firms of the capitalist countries.

Here much is governed by the trends which are clearly traced in today's complicated world. They also affect the development of modern science. On the one hand, the mighty law of the cooperation of labor is in effect. Scientific activity obeys it just as objectively and to the same degree as does physical production. On the other hand, each scientific center belongs to the country in which it operates, therefore it can be susceptible to pressure, to the discriminatory measures which are introduced unilaterally by the government of several countries of the West to halt the exchange of scientific information.

But is isolationism in the area of science possible? Abstract or applied science? For scientists, as has already been said, have to solve very difficult problems. The equipment of our days, and especially the equipment of the next century should be adapted for extreme operating conditions. Temperatures, speeds and pressures are increasing, the conditions of the operation of machines, devices and apparatus are becoming more complicated, the demands on reliability are greater and greater. These problems are urgent and require for solution the joint efforts of large collectives. That is why the establishment of lasting international relations is a component of the work on the development of an efficiently operating mechanism of the management of scientific and technical progress and helps to ensure its constant acceleration. And every state is interested in this.

Recently one of the leading Japanese firms, Sumitomo, requested at the Institute of Superhard Materials of the Ukrainian SSR Academy of Sciences samples of synthetic superhard materials and tools made from them. The course of events is quite natural: advanced processing methods enjoy a great demand on the international market, they are literally being pursued.

We also see this at such "hot spots" as the methods of the transfer of large amounts of petroleum and gas over large distances. The laying of pipelines is connected with the problem of reliability, our institute is devoting much attention to resistance to the origination and spread of cracks.

World practice knows of many instances when in pipes, which operate under high pressure, so-called cascade failures occur: a crack, literally exploding the

pipes, rushes along them faster than sound over a distance of several kilometers. Shutdown for repair involves large losses. Scientific research showed that it is possible to prevent cascade failures. Crack arresters have been developed at our institute. This technology has aroused immense interest among western firms which are involved in the construction of pipelines.

Our institute for more than 10 years now has been developing scientific and technical relations with the German Welding Society, which unites a large number of leading firms and scientific research organizations of the FRG. Cooperation is also taking place with individual firms of the GDR: Messer Griesheim, Mannesmann, Thyssen, Hoesch and Saltzgitter.

We are also cooperating with firms of Sweden and the United States. McDermott, an American firm, on the basis of a license purchased from us and with the participation of our specialists has performed this year much work on the welding of thick-walled pipes. In turn the same firm has shared with us the know-how of the construction of marine pipelines of large length, as well as the organization of welding operations on pipe-laying ships.

Licenses are an important form of scientific and technical exchange and are a mutually advantageous business. The seller (the so-caller licensor) obtains the opportunity for the partial recovery of the expenses connected with the performance of scientific research and experimental design work. While the purchaser (the licensee) saves time and receives at his disposal tested material, technology and plant. For example, after the Japanese firm Nippon Steel purchased in the USSR a license for the use of a system of the transpiration cooling of blast furnaces, in a year a record of the daily smelting of pig iron in accordance with the Soviet processing method was established in the city of Nagoya. After this the firm purchased a new license for a plant for the dry quenching of coke. These plants were also purchased by firms of Italy, the FRG, France and Brazil.

Experience shows that foreign firms make available information on their latest achievements only if they are themselves very interested in our developments or in promising ideas. It is necessary to support and stimulate more vigorously first of all the researchers, whose works are at the level of world achievements.

The dissemination of information on each achievement in science is now taking place with great intensity, and this is making it possible to quickly reform industrial practice in various countries. That is why they grasp at once even an incomplete idea, if it contains a grain of innovations. I believe, however, that it is more profitable for our scientific centers themselves to bring promising works up to such a level, when it is possible to sell a ready-to-use processing method.

For the Sake of New Processing Methods

In our opinion, success on the world market in many ways is connected with the objective necessity for the "technological orientation" of major scientific forces. The joining of theoretical and experimental research with applied research leads to the emergence of a fundamentally new class of scientific

operations--purposefully basic operations. Not inferior to what is called "pure" science in depth and fundamentality, it is infinitely more efficient. Now, as domestic experience and the experience of foreign countries show, the process of the utmost broadening of such research is already occurring. Several years ago it was isolated, it is possible to list it--thermonuclear fusion, computer technology, the development of space.

The main advantage of purposefulness is that the research at all stages of performance is oriented toward the obtaining of end results in the form of important technological decisions.

This new form of work requires careful preliminary analysis. It is necessary to know international market conditions well, in order to determine confidently the group of most important problems, on which purposeful basic research should be conducted. Here the consideration of the long-term trends in the development of social production is important. Thoroughly substantiated forecasts (with allowance made for the forecasts which are being made abroad) will make it possible to increase the practicability of long-range plans and scientific and technical programs.

The processing methods of a different level and purpose, which have been developed by Soviet scientists, are a great value, this is a part of our national wealth. Unfortunately, this wealth is not always used efficiently and with the proper scope. The matter often reduces to paradoxes. Domestic developments, for which licenses are sold to foreign firms, are assimilated significantly more rapidly by them than by us, and then are imported to our country.

Today, unfortunately, the majority of new developments are introduced in our country only at one enterprise and only a small number are introduced at five or more enterprises. Such a situation must be resolutely improved. The development of new equipment is a factor of the strengthening of our independence from foreign economic deliveries.

Such independence, as we have demonstrated many times, has quite real bases. Here is an example from recent history. The country needed urgently and quickly metal of a very high quality, which until a certain time was not produced in our country. Western firms attempted to threaten us with what they are now also trying to intimidate us: a policy of embargo in the sphere of scientific ideas and the curtailing of scientific and technical exchange. Just as now, we responded that the harm here is mutual, while the rupture, although unpleasant for us, is not a deadly threat.

Our academy conducted purposeful basic research, which concluded with the development of an electroslag processing method which has received world recognition. This processing method marked the beginning of a new sector of industry--specialized electrometallurgy--which provides metals of the highest quality.

Now they are threaten us, the Soviet people and the trailblazers of space, with "Star Wars." I believe that the rapid breakthrough of mankind into space will lead to different, entirely peaceful consequences. However, it is

necessary to be realists. The problems, to which going into space gave rise, are quite complicated and also require the combination of the efforts of mankind. It is a matter not only of the astronomical amounts, which are required for the implementation of space programs, but first of all of the importance, which they may have for mankind as a whole and each country individually. This is one of the most important modern problems which it is customary to call (which is very precise) global problems.

Of course, the successful solution of all global problems is possible only in case of the solution of the main one--the prevention of nuclear war. I would like to conclude the article with words which are about five centuries only, but today they are topical as never before.

In the treatise "The Complaint of Peace," which was written by the outstanding scientist and humanitarian of the Renaissance era Erasmus of Rotterdam, it is stated: "Let the greatest honors be paid to him who averts war, who by wise counsel restores harmony and who by all forces acts so that grand armies and enormous stores of weapons become unnecessary...."

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CSO: 1814/31A

SOCIO-POLITICAL FACTORS

SOCIAL ACTIVENESS OF SCIENTISTS

Tallinn SOVETSKAYA ESTONIYA in Russian 20 Oct 84 p 2

[Article by A. Favorskaya: "The Personal Position"]

[Text] In journalistic practice once a conversation with one Tallinn economics scholar (one of the managers in his own collective) bewildered me a lot. To the request to suggest, which of his colleagues would tell in an interesting way in the newspaper about the problems, on which they are working here, the scholar replied disapprovingly: "Some are working, others are writing articles."

And there was another instance, which was the opposite, when an executive of a large (Novosibirsk) institute, who was loaded with business, a man who is well known in the country for his innovative contribution to industry, specially made time for a touring journalist. It seemed so important to him to spread in this case through the press his successful experience of cooperation with experienced workers.

A position is also a position. Strictly speaking, right here there is also reflected, perhaps, much that makes it possible today to evaluate the real efficiency of specialists. It is a question, of course, not only of articles or other appearances before the audience at large, although people, of course, should and want to know, on what scientists are working, what major goals they are setting, how they take into account here the real demands of our life. Without such information it is difficult to develop among people what is called a modern type of thinking, but this would also mean to leave the efforts of science without our common support.

The question is, it seems, broader: OF THE SOCIAL POSITION, THAT IS, OF THE ACTIVE PARTICIPATION OF THE SCIENTIST IN ALL THE MAIN CONCERNS BY WHICH SOCIETY LIVES [in boldface]. The civic attitude toward one's Cause in combination with enterprise--this is in what the social activeness of the scientist, if we speak to the point, is seen.

It has been noted that precisely such an attitude also frequently decides the success of the Cause itself. True, behind its social recognition in these cases we can see more often only the result itself: a special design bureau of computer technology has been set up, lasers or new means of plant

protection have been developed, a multilateral study of the geology of the Soviet Baltic region has been made. But in reality behind these facts every time there are also both the unmeasured labor and the invaluable irrecoverable nerve cells of the authors, which have been spent to convince, interest and attract in time experienced workers, to determine the competitors--for something NEW [in all capital letters], which previously DID NOT EXIST [in all capital letters], but which should (should without fail!) now become a part of our common life, has been developed. But how is it otherwise?

A group of specialists of the Institute of Cybernetics of the Estonian SSR Academy of Sciences and the Slantsekhim Production Association 2 years ago became winners of the State Prize of Soviet Estonia. Their "creation"--a system of the automated control of technological processes, which they developed and introduced at a carbamide works--in complexity is comparable to the flight control system of a spacecraft--here the instantaneous reaction to a large amount of continuously changing input data is also required. The scientists knew that the embodiment of the idea of such an automated control system would require of them several years of work at the limit of their strength, that much--even the technical base--would have to be created literally with their own hands, since a special organization for this did not exist. Did they take the risk? Undoubtedly. But water does not flow under a lying stone! To take upon themselves meant for them the only practicable opportunity for today to bring their research closer to the needs of practice. "Who is it, is not us?"

To be able, while being concerned about the Cause, also to assume the risk. To study not simply an interesting phenomenon, but a problem which has a broad outlet. To strive to see one's own useful idea introduced, to absorb others with it. Are these principles really not visible behind every worthwhile scientific achievement and its broad recognition? And, on the contrary, do not except a useful outcome, and especially social repercussions wherever the researcher thinks in narrow terms, within only his own specialty, without being interested in its interconnection with others, without being able and without desiring to project today's problems into the future.

In any area of activity we proceed from reality. Real life also requires today that a competent specialist would display initiative, would boldly state his competent opinion, would suggest the necessary steps and would assume responsibility. The human factor. The personal position at all levels of activity. Today, perhaps, we do not have anything more important than this reserve in scientific and technical progress.

Why, for example, did the successes of the Institute of Chemistry of the Estonian SSR Academy of Sciences become especially obvious precisely in recent years (here a large number of new developments were brought to a direct outlet into practice)? For earlier research was conducted in the same directions, but it was a long way to introduction. Yes, of course, the very fruits of scientific research have also ripened. But not only that. Now an entire strategy of introduction, in which everything that shortens the path of an idea to production has been incorporated, has been jointly formulated here. Including enterprise, a sense of the times and the ability to take a risk in the name of the cause. But the main thing is that these valuable qualities,

which it was possible to apply in full only to individual associates, are gradually rising up to the position of the collective. It is also even possible to name a specific person, who assumed the difficult management of such a strategy: deputy director for introduction Yuri Soone (we rarely still, incidentally, name the people, who "take much upon themselves," and hold them up as an example).

"What position among scientists do you come across more often, whom, according to your observations, do you have more of--active or passive ones?" "I believe that for the present there are nevertheless fewer active ones. And it is understandable why: it is significantly easier to engage exclusively in one's own work." "Does this disappoint you personally?" "Of course! I supervise, for example, graduate students. More than half of them, it is true, already during graduate studies have defended dissertations. But the other half does not display initiative--hence, they are not independent and not active, although they are preparing to work in science. But a scientist needs to know how to fight for his ideas, for their embodiment." "Is this a part of your idea of social activeness?" "I believe that for the scientist it is appears precisely in this."

The person I am talking with is Anto Raukas, a well-known geological scientist and a corresponding member of the Estonian SSR Academy of Sciences. At the academy he is in charge of the Chemical, Geological and Biological Sciences Department. Many tens of works have been written by him--from serious monographs to journalistic articles. He supervises the Soviet section in four international research programs. Moreover, he founded and took under his wing "the little academy"--the republic scientific society of school children (where they strive to carry out entirely real science). What else is he? A member of several authoritative expert commissions at the republic level (for phosphorites, water resources and so forth). A deputy of the city soviet. A member of the republic Committee of People's Control. Do you think that he is hoary with age? By no means. He is not even 50 (incidentally, he is an expert of the sport of tourism).

I do not ask Raukas where he gets the strength and time for all these diverse duties, which he has been performing conscientiously for many years (in the Society for Knowledge he recently received even a medal for activeness). But what, it would be interesting to know, does this diverse activity give him as a scientist, as an individual?

"You see, about 5 years ago progress in all areas did not rely so obviously on science. But now it is absolutely clear that only science is capable of giving really new solutions to the national economy. In our republic it is the same. And here one simply cannot do without a knowledge of the problems outside one's narrow specialty. For example, a comprehensive program on the use of the natural resources of the northeastern part of the republic was elaborated. As the chairman of the coordinating commission for this question I now fancy how interconnected the problems of this region are: geology--with biology, health care and so on. As a result you act more soundly, since you see the problems and propose measures not only from your own, the geological 'mound.' Being a deputy and work as an expert help to achieve a qualified solution of some other vital problems. So it also is with other colleagues of

mine, very likely." "And all the same among scientists exclusiveness, the privacy of interests and at times an everyday approach to the problems facing society still occur." "I believe that there is less of this wherever it is easier to see that something changes because of your suggestions. Many arguments on how to publish our Estonian Soviet Encyclopedia are now taking place. If it is by means of computers, in the publication of such works this would be a genuine turning point. And, do you know how Mart Remmel', the young deputy director of the Institute of Language and Literature, is fighting for this? (He is a candidate of philological sciences, by the way.) As his vital concern! He is making, of course, many 'enemies,' but he is not afraid of them. Here is an active social position." "And are your cyberneticists, once again, really not an example? How they are promoting now microprocessor equipment, which they call the catalyst of the scientific and technical revolution! They are promoting it themselves, on their own initiative." "Of course. Because without a revolution in our thinking automation even in accounting is inconceivable, let alone in industry. An active position here is simply necessary. The same thing goes for physicists: efficiency, civic spirit. Their own leaders, whom it is worth emulating: Peeter Saari, director of the Institute of Physics, for example. He has also devoted much effort, by the way, to Komsomol work. Or the veterans of our science, this ageless example of great activeness...." "And activeness to this day, which is characteristic!" "Exactly. Academician Kharal'd Khaberman (and he is close to 80) quite recently published in a year five scientific works, among them one monograph. Academician Iogan Eykhfel'd has celebrated his 90th birthday, and how many of his articles are being published to this day on the most urgent--the fodder--problems in our dairy animal husbandry! And here, you know, last year he developed in his spare time new strains of primulas. This is little: he received for them four certificates of authorship!"

Yes, the talent of a researcher and a social temperament do not exclude each other. That is how it has been at all times. Back in antiquity Plato spoke well about the civic purpose of the scientist: "He is 'appointed to look after' our city like a horse, which is large and noble, but has gotten lazy from obesity and needs some gadfly to urge him on."

Today in the world everything is far more complicated and dynamic: the problem of human might is closely connected with the preservation of life itself on earth. The responsibility of scientists has increased greatly.

"...And hence, the demands on us also have," Raukas says to me. "Natural conditions and the life of people by the end of the century should not worsen as against the present ones. This is where both civic activeness and a personal position will be required of all of us."

Just as, by the way, everywhere, in the solution of any urgent and immediate problems which arise in the national economy of the republic.

The demand for the "human factor" is special today.

7807
CSO: 1814/27

GENERAL

GOALS, PROBLEMS OF SCIENCE IN 21ST CENTURY

Moscow NEDELYA in Russian No 43, 22-28 Oct 84 pp 14-15

[Article: "Science of the 21st Century"]

[Text] These days the journal NAUKA I ZHIZN' is 50 years old. Its first issue appeared during the busy time of the 2d Five-Year Plan, of which the completion of the technical modernization of the entire national economy was the main economic task. The goal of the journal--the first popular science publication of the broad type for adults in the socialist country--at that time was "the acquaintance of readers with science as a tool of the reform of life." Academician V. Engel'gardt called today's NAUKA I ZHIZN' a pilot in the boundless ocean of information. The popular science journal of the All-Union Society for Knowledge now appears with a circulation of 3 million copies and is intended for the broadest circles of readers. Of course, it is very difficult and, probably, impossible to see to it that all 160 pages of it would attract any reader. But we are striving for this, at any rate, we are trying to see to it that every member of the family, which receives the journal, would find in it the information and the themes, in which he is interested. And here it is necessary to note: the ever increasing interest in the achievements of modern science, in the urgent problems and the prospects of scientific and technical progress in many ways, undoubtedly, is contributing to the increase of the popularity of our publication.

The readers, the most active authors and the collective of the editorial board perceived with much gratitude the awarding of the Order of Labor Red Banner to the journal NAUKA I ZHIZN'.

I. Lagovskiy, editor in chief of the journal

The editorial board turned to a number of scientists with the questionnaire "Yesterday, Today, Tomorrow." We are citing here excepts of several responses to the last question of the

questionnaire--"What level will your field of science reach in 50 years? What cardinal problems, in your opinion, can be solved, what tasks will worry researchers during the first third of the 21st century?"

Academician V. Ginzburg

Perhaps, by 2034 the limitedness of the quark model will be explained and physics will move to the next, "more profound stage"--the existence of protoquarks (particles, of which quarks "consist") and some new physics, which conforms to them, will be proven. But at present the hypothesis that quarks are the last "bricks" of matter and further subdivision does not conform to reality, is also entirely admissible....

It is not ruled out that quarks somehow will all the same appear on the front stage not only in high energy physics, but also, for example, in nuclear power engineering, although I regard this as improbable. Incidentally, it is also hardly necessary to worry about the fate of nuclear power engineering without any use of quarks. It is hard to doubt that by 2034 thermonuclear reactors and nuclear breeder reactors will supply us with all the necessary power. More precisely, they will be able to supply the power, which it will not be possible to obtain without them on the basis of the use of solar radiation and other "clean" and practically inexhaustible sources.

Academician A. Lyul'ka (This is one of the last publications of the recently deceased Arkhip Mikhaylovich Lyul'ka.)

It is quite obvious that the possibilities of the improvement of the performance of turbojet engines, which run on traditional fuel, in the next 20-30 years will be exhausted. Engines, which run on a new fuel, will be developed later. Hydrogen is considered one of the most promising. Today they are using it abroad in rocket engines.

Such a fuel for thermal engines has a number of advantages over organic fuels. The califoric value of hydrogen is approximately 2.5-fold greater than their califoric value. The basic product of the combustion of hydrogen is water vapor, therefore the atmosphere is not polluted with substances which are harmful to nature. The reserves of hydrogen on earth are practically unlimited.

A high-temperature, high-pressure, nonafterburning, hydrogen, multistage turbojet engine with a controlled operating process will come to aviation. Hydrogen ramjet engines will be installed on hypersonic airplanes. Dirigibles with engines running on hydrogen fuel will receive extensive use.

It is possible to assume with sufficient certainty that in the next 50 years on the basis of the use of nuclear power plants in industry and on deep-sea vessels nuclear fuel will be introduced in aviation.

Heavy transport planes with a long range, obviously, will be the first planes with engines running on nuclear fuel.

Academician of the All-Union Academy of Agricultural Sciences imeni V. I. Lenin A. Sozinov

First of all the problem of the transfer of individual genes or sets of them from one organism to another will be solved. This will make it possible to engineer new forms of plants and animals, which have been adapted to industrial processes of the production of foodstuffs and raw materials for industry. These will be organisms which differ significantly from present organisms. For example, barley which is capable of fixing atmospheric nitrogen, growing on acid soils and synthesizing in the grain full-value protein which is equal in quality to the proteins of soybeans. New forms of animals, which require much less fodders than current animals, will be developed. The number of biologically active substances, including new miracle medical compounds, which will be produced in a mass quality by microorganisms on the basis of recombinant molecules of DNA, will increase immeasurably. Probably, many modern industrial processing methods will be organized on the basis of biotechnological processes and even the dressing of ores will begin to be carried out by means of specially engineered strains of microorganisms.

Corresponding Member of the USSR Academy of Sciences Ya. Tsypkin

The future of the science of control, obviously, is connected with the symbiosis of analytic and algorithmic methods. It will become possible to make "what is needed as is needed." The use of computers will make it possible to design systems not in advance, as is now done, but in the process of the operation of the controlled object and owing to this to ensure the efficiency and optimality of the entire system as a whole. These will be versatile, adjustable systems, which are capable of the automatic elimination of defects and adaptation to changing conditions....

New types of robotic systems with artificial vision, sense of touch and intelligence will appear. Such systems will be able to operate reliably under water, underground, on the ground and in space. They will begin not only to set up and conduct experiments, but also to process their results, draw conclusions from the obtained data and then to take the necessary actions. Versatile automatic systems will play an enormous role in the automation of scientific research itself, the advancing and checking of hypotheses and theories.

Corresponding Member of the USSR Academy of Sciences G. Ivanitskiy

It is possible to name several global scientific problems, to the solution of which biophysics could make an appreciable contribution. These are, first, the development of methods of monitoring the changes of the habitat of man; second, the further development of preventive treatment, diagnosis, the maintenance and restoration of our health; third, the search for means of providing man with food; fourth, the determination of versions of the efficient use of the decreasing reserves of minerals....

The going of man into space has changed our understanding of the world. Mankind has realized how small our earth is and has understood that it is

necessary to interfere extremely cautiously in the processes which are occurring in nature. One of the main biophysical tasks of the 21st century, to the accomplishment of which biophysics should make a significant contribution, is the achievement of harmony between man and nature. There are several aspects in the biophysical approach to the accomplishment of this task.

Ecological, or perennial, natural cycles have still been studied inadequately, but meanwhile their understanding is necessary for the better coordination of our life with the "clock" of nature. All organisms, from the simplest to vertebrates, by utilizing energy and the "products" of their own ecological neighbors, give the product, which has been created by them, to a "neighbor" of a different species. This flow line with waste-free production and a closed production cycle exists due to the energy of the sun and constitutes our habitat. For the disturbance of the established "production cycle" it is necessary to pay with the additional consumption of energy. The adaptability of the biosphere to a change of external conditions is a regulated process, in which in the process of evolution one species many be replaced by another, and at the same time this is a flow of moving dynamic equilibriums. Two connected factors have not made it possible to far to see clearly the rhythm of the biosphere, as well as to caution man with great certain and, as they say, for all cases of life against ill-considered interference in nature.

One of these factors is the great diversity of living organisms. All living organisms, including people, differ genetically to a much greater extent than was thought 10-15 years ago. Two randomly chosen people will differ with respect to hundreds and, perhaps, thousands of chromosome loci. Such differences are important, many of them are connected with sensitivity to a change of the parameters of the environment and determine the adaptability or even the possibility of the survival of individual organisms, reminding us that natural selection is continuing.

The second factor is connected with the fact that in the biosphere there is a large set of processes of regulation with feedback and as a consequence a set of cyclical processes, which enable it to compensate for the changing conditions. Therefore the biosphere copes comparatively easily with the tasks of the automatic regulation of the living conditions which it needs. If man, when interfering in the operation of this automatic machine, makes mistakes, a high price is exacted for them, at best in the form of large capital investments which are needed in order to correct the situation, and at worst as a threat to the very conditions of the habitation of man, a threat to our health....

One of the most important tasks of biophysics is to examine the cyclical nature of the processes, which occur in the biosphere, and to formulate specific warnings.

Corresponding Member of the USSR Academy of Sciences V. Troitskiy

In 50 years, it must be assumed, interstellar probes for sending to one of the closest stars within distances of 5-10 light years, of course, to one, around which planets will be discovered, will be developed. I believe that such a

craft will move with a speed of not more than one-tenth the speed of light, by means of a thermonuclear engine....

Special large radio telescopes for the observation of and search for electromagnetic signals of intelligent (artificial) origin in the entire promising wave band will be built. Observations of signals from a significant portion of the stars of the galaxy will be made. The theory of the origin and development of extraterrestrial civilizations will undergo further development.

Professor V. Dil'man

Scientists calculated long ago that starting with the age of 30 every 8 years the death rate among people increases by twofold. In other words, half as many people 30 years old die as people 38 years old, while half as many people 38 years old die as people 46 years old and so on. If the death rate among people was kept at the level of people 30 years old, the maximum life expectancy of a person would exceed... 1,200 years (!!), while more than half the people would live more than 350 years!

It is possible to believe and not to believe these calculations, but it is obvious that the problem of the length of the life of a person will become one of the central ones and will be solved by different means. One of them is the development of methods of not only the detection of genetic defects, but also their correction. The possibility to control genetically the occurrence of diseases, including specific types of diabetes and early atherosclerosis, will appear.

The second method of increasing the length (and quality) of life will consist in the maintenance of homeostasis at the level, which is achieved by the end of the growth of the body. This will be done by means of both medicinal and other actions. In particular, methods (including genetic), which decrease the frequency of injuries to cells, will be developed. This will slow the occurrence of normal diseases (that is, diseases which are linked with the mechanism of the development of the body) and will also increase the length of life.

Corresponding Member of the USSR Academy of Sciences S. Lavrov

In 50 years the desk and even pocket computer with possibilities, which are not inferior to, but rather exceed appreciably the possibilities of modern massive "large" computers, will become just as customary as wall clocks or wrist watches. Any professional activity will be carried out only with the use of these handy means....

I believe that in half a century scientists will be working intensively on the possibility of developing logic elements of circuits at the molecular level. I do not undertake to say whether these will be protein-like or completely different molecules, but I believe that only this means will reveal a way out of the deadlock, at which electronic and optoelectronic engineering will sooner or later be. When this "molecular" means has been assimilated, the

opportunity will be afforded for the development of machines which approach in their possibilities the brain of animals and man.

Corresponding Member of the USSR Academy of Sciences P. Simonov

formation of the sphere of needs and the motives of man (first of all in his production and social activity) will improve the understanding of the behavior of man, the processes of the formation of his personality in early childhood and at adolescent age, as well as the nature of deviations, which will contribute to the formulation of a scientifically sound theory of education.

Corresponding Member of the USSR Academy of Sciences S. Yefuni

In the year of the birth of the journal NAUKA I ZHIZN' (1934) the science, in which I am engaged--hyperbaric medicine (or else hyperbaric oxygenation), that is, the use for therapeutic purposes of oxygen under increased pressure, already existed, but was at the lower point of the curve which expresses its development....

Now the therapeutic hyperbaric chamber has become in our country a customary attribute of the majority of general hospitals, while the physicians, who work in this area, are experiencing a constant press on the part of patients who are trying to be treated in these departments.

How do I imagine the future of hyperbaric medicine? I believe that it will not only deal with the treatment and prevention of diseases, but will also take in a significant portion of our creative life. In small comfortable halls responsible meetings will take place, poets will write poetry, having reliably ensured inspiration by the increased oxygenation of the brain, future mothers will knit children's booties in hope for the birth of brilliant babies, while at this time the most modern computers will provide not only the optimum level of oxygenation in these halls, but also a fresh breeze, the smells of pine trees or flowers, the twitter of birds, the noise of the sea or low music, depending on the tastes of our patients.

Academician B. Kedrov

I can express the hypothesis that the prediction of Marx, which was advanced by him in the 1840's, will be realized quite thoroughly by 2034. It is a question of the merging of the previously separate natural and social sciences into a unified science of the distant future. I have been dealing now for about 40 years with the problem of the classification of sciences. I have written a trilogy, the last volume of which is devoted to the prediction of Marx about a unified science of the future. The traced trends of the modern development of natural science, especially in the area of the scientific and technical revolution, indisputably attest that the interaction and interconnection between the social, natural and technical sciences are increasing with each year, and therefore it can be asserted with good reason that in the next half a century this trend will take pronounced organizational forms.

The need for the elaboration of a comprehensive method of research, which enables scientists to examine the particular in its inseparable connection with the general, is in direct connection with this process. The unified science, which was predicted by Marx, will be based on the dialectical method of cognition: it will not exclude narrow specialization and will not merge all scientific knowledge into one indistinguishable whole, but will make it possible to delve deeply into the knowledge of one field or another, encompassing in so doing all activity as a whole. By such a general method of scientific cognition Marxist-Leninist dialectics will be raised to a higher level.

7807
CSO: 1814/30

GENERAL

FACTORS BEHIND SCIENTIFIC, TECHNICAL PROGRESS

Moscow SOVETSKAYA ROSSIYA in Russian 13 Jul 84 p 1

[Article by Doctor of Technical Sciences professor V. Zyuzin: "The Energy of Progress"]

[Text] The opinion is forming that the greatest barrier in the way of the acceleration of scientific and technical progress is the inertia of our thinking, obsolete stereotypes and concepts. A peculiarity of the moment is that everyone votes in favor of scientific and technical progress, but many still lack the resolve to proceed from words to deed.

An enormous amount of metal is becoming chips. Meanwhile automated technological processes of mechanical working as compared with the rough cutting of round items increase labor productivity by 5- to 10-fold and more, save up to 15-30 percent and more of the metal, improve the quality of items, free machine tool operators, decrease the product cost and speed up the recovery of expenditures. Many years of practice have confirmed the economic expedience of new processes: about 400 part rolling mills are in operation at many machine building plants of the country. Many more of them are needed. But the improvement of metal-cutting machine tools is continuing, the problem of the shortage of machine tool operators is being worked on. Science is making the theory of cutting more precise, dissertations are being defended, professors are getting into the heads of students the "efficiency" of the process of cutting, cultivating among them its supporters already for a generation ahead.

There are many such examples. And among the objective and subjective reasons there is one, a basic reason: under the formed conditions the content of scientific and technical progress frequently comes into conflict with its traditional forms of management, which is curbing the interest in the development of advanced equipment. Precisely interest is the "internal motive force" of scientific and technical progress. This concept is profound and multilevel. It includes not only material interest, but also the fundamental need of specialists to conduct scientific research, to develop new technology, to develop an original design of a machine, an instrument, a system. The development of this interest will naturally lead to the organization of such forms and relations, in case of which specialists and managers, organizations and plants, ministries and departments will be

economically interested in the search for, development and rapid and extensive introduction of advanced equipment.

In what does the unity of the form and content of scientific and technical progress consist? Let us try first to understand its ideological and material essence, its "mechanism." Scientific research--the origination and substantiation of an idea--is the most important stage of the ideology of the development of new equipment. New major ideas, as a rule, are a result of basic scientific research. Frequently they arise at the meeting point of fields of knowledge and sectors of the economy and are of an intersectorial nature. It should be noted that the fundamentality of an idea is characteristic not only of science, but also of equipment and technology--the process, the machine, the material. The discovery of contradictions, the errors with their evaluation and overcoming and, finally, the establishment of laws are characteristic of the process of scientific cognition. This stage is most susceptible to the taking of risks, while its results lend themselves least to planning. But without the development of technology, without a design decision an idea remains just an idea which has not been embodied in the material essence of progress--a machine. The introduction of a major idea is the continuation of the creative process, this is always a step into the unknown, which is accompanied by the taking of risks.

Specialists, who are devoted to a cause and work at the edge of scientific and technical progress, always take risks deliberately. That is why they end up more often in conflict situations and are more vulnerable than others from the standpoint of various kinds of statutes and instructions. Moreover, the possibility of mistakes is also incorporated in the taking of risks. "Whoever does not take risks, does not make mistakes." But hence the conclusion: if you do not want to make mistakes, do not take risks. This is not uttered aloud. The position often finds expression in playing safe, in the desire to evade decisions in a risky matter, to wait a bit before answering and to put the question through a round of discussions and consultations.

In the past decade, as the analysis shows, the number of fundamentally new types of machines, which found application in the national economy, did not increase but, on the contrary, decreased. The basic research in the area of science and technology of the 1950's and 1960's in many ways has reached its limit, while the development and introduction of new ideas are being checked. And the need to carry out developments of transforming importance was very opportunely stressed again with particular urgency at the February and April CPSU Central Committee Plenums.

Frequently one has occasion to hear that it is first of all necessary to invest assets in the areas of knowledge, which yield the quick return. Such a market view of the development of the economy leads to the dispersal of the creative potential and aims it not at the development of fundamentally new models of equipment, but at the improvement and modernization of operating processing methods and machines. It is now important to step up basic research and to achieve its closer practical connection with the sectors of industry and with the rapid appearance in the end result. World experience attests that to economize in science is an impermissible luxury, the proportion of the expenditures on it should lead the growth rate of the

national income, which stems from the need for the increase of labor productivity and the improvement of the quality of goods with the increase of their competitive ability on the world market. What levers of scientific and technical progress should we put into action? First of all it is necessary to take the path of the increase of the skill (but not the number) and the capital-labor ratio of scientists and engineering personnel, as well as the increase of the proportion of the output of "science-intensive" products. Here it should be noted that no field of science can be developed successfully without its supply with scientific instruments and computer technology. Therefore it is extremely important to establish in the country a subsector of scientific instrument making and to develop pilot works intensively.

Scientific and technical progress, in addition to knowledge, requires of its ideologist-specialists such qualities as willpower, persistence and flexibility, the ability to persuade, to achieve the set goal--everything that constitutes not only a scientific engineering, but also a civic stand. Without this new equipment does not come into being and is not introduced.

The cultivation of progressive economic thinking and fighting qualities should begin with the radical improvement of the training of scientists and engineering personnel. What is intended? The information explosion, as a result of the scientific and technical revolution, is aggravating more and more the contradiction between the need for the mastering of a set of increasing knowledge and the existing forms of passive training, in case of which the students listen and memorize more than they think independently, which also gives rise to a style of work, which lacks initiative, among future specialists, often for their entire life.

The idea of intensification, in our opinion, should permeate the entire system of the education and training of personnel, beginning with school and ending with production. The goal is the training of creatively thinking specialists with a high level of knowledge, with initiative and civic responsibility. Precisely such a type of specialist governs the acceleration of scientific and technical progress. But it, of course, also requires a different view of the methods of instruction, the programs and textbooks, first of all the instructors and professors, who along with great professionalism and a broad outlook would have the ability to approach the audience in an individualized manner, to know how by discussions to induce students to actively interpret the materials and to independently draw conclusions.

At present more than half of all the doctors and candidates of sciences work at the higher educational institutions of the country. Such a statistic makes it possible to think that our enormous scientific potential is still being used poorly for the increase of the efficiency of social production. Apparently, the time has come to reconsider the attitude toward the system of technical education as a "nonproduction sphere." Economists note that the value of acquired education relative to the value of fixed production capital exceeds one-third! But, as is known, the increase of the national income is accomplished by means of the effect of two factors: the increase of the number of workers in the sphere of physical production and the increase of labor productivity. The latter is ensured both by the technical equipment and efficient organization of production and by the increase of the education and

skills of workers. It is characteristic that in the past two decades the average annual growth rate of the national income due to the increase of the education and skills of personnel was 1.5-fold greater than from the increase of the technical equipment of labor. In this connection the concern of the party about the increase of the efficiency of the educational system seems extremely topical.

The problem of the influx of young personnel is one of the fundamental issues, which is inseparably connected with the problem being examined (and, apparently, not only with it). The growth rate of the number of scientists in the 1970's declined to nearly two-fifths. This process will also continue in the future, it is especially noticeable among highly skilled workers. For example, the proportion of doctors of sciences over the age of 50 now comes to about 70 percent, while under the age of 40 it comes to 4 percent.

The constant influx of young forces into science, technology and production is a natural necessity. It is important to create the conditions, under which specialists of retirement age could continue their work, not necessarily while holding staff positions, but in the role of officially approved advisors, consultants and others. Such an approach, it seems to us, will stimulate the influx of young personnel and will make it possible to achieve the economical use of the large creative reserve made up of specialists of the highest skills of the older generation.

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CSO: 1814/28

GENERAL

PROBLEMS, STRATEGIES OF INTRODUCING NEW EQUIPMENT

Moscow SOVETSKAYA ROSSIYA in Russian 18 Sep 84 p 1

[Article by Candidate of Economic Sciences M. Bashin, member of the Scientific Council of the USSR Academy of Sciences for the Economics of Scientific and Technical Progress: "The Strategy of Introduction"]

[Text] Bridges of different designs have been erected from science to production, but their capacity is still limited. A high-speed route has still not always been prepared for the technical innovation. The smooth road on its path is frequently replaced by pot holes, and introduction is delayed for a long time. The formation of a network of scientific production associations made it possible to alleviate this urgent problem.

The guideline of associations is the solution of combined problems. Practical experience has shown that they are most suitable in sectors with a long cycle of the development and assimilation of new equipment. Here they are powerful catalysts of technical progress and materialize scientific ideas and advanced technological approaches. As a result a great impact is achieved--the time of the assimilation of an innovation is shortened to two-fifths to one-half. This is an important component of the strategy of implementing scientific research and major inventions. Here is a typical example: the Plastpolimer Scientific Production Association of the Ministry of the Chemical Industry assimilated assemblies with a large unit power in 5.5 years. Previously 10 to 11 years were spent on this.

There are now 250 scientific production associations in the country. This is not many, but an important role in the assimilation of innovations belongs to them. For example, in Moscow of the total number of descriptions of products with the State Emblem of Quality more than 70 percent were developed precisely at such associations.

If we speak about a drawback, it consists in the fact that associations work on problems which have been localized by the boundaries of the sector. But today fundamentally new and, hence, efficient equipment or technology is often of an intersectorial nature. Let us name several of them: powder metallurgy, the plasma machining of metals, the technology of explosion welding, robotics and others. In the future the number of such problems will increase rapidly.

The scale of the use of an innovation to a significant degree depends on production workers, their sense of what is new and the ability to see the future. However, the corresponding mechanism, which would take into account not only positive experience, but also the possibility of shortcomings and difficulties, is also necessary for this.

Several economists see a solution in the organization of specialized introducing firms, which are ostensibly capable of taking upon themselves the entire burden of assimilating innovations. It is assumed that such a firm will become an active intermediary between science and production and will perform the entire amount of work on a contractual basis, including the operational development and placement into production of promising innovations.

It is impossible also not to see the arguments against such a solution. First, is it expedient to create another level of management? The assimilation of an innovation requires not only the development of the processing method, the replacement of the basic equipment and often the renovation of the enterprise, but also the setting up of a new, extremely sluggish system of technical supply. The danger lies in the fact that such firms will be a find for those who still prefer to live by the principle: "Here comes the master, he will settle our dispute." They devise legal terms for shifting the heavy burden of introduction onto the shoulders of others.

A scientific idea, no matter how fruitful it is, is only a stimulus, the energy of the initial burst for future production embodiment. In his day Academician M. A. Lavrent'yev correctly stressed: "Only the people, who developed it and know it firsthand, can introduce a fundamentally new idea in industry. The failure to understand the profound essence of a discovery often makes it incumbent to take the path of so-called partial introduction, when they attempt to fasten the heart of a new idea to the trunk of an old one."

Figuratively speaking, the setting up of firms, in our opinion, can have the result that there will taken from the breast of the mother her own child for rearing by a strange woman. The effectiveness of the activity of scientists of the world famous Institute of Electric Welding imeni Ye. O. Paton is based first of all on the fundamental continuation of their research and development in the form of direct participation in the introduction of innovations. The active, vigorous form of the embodiment of the obtained results in metal is the successful strategy of this leading collective. If these functions are turned over to other organizations, the high level of domestic welding technology, which has received universal recognition, will rapidly decline.

It should also be recalled that the setting up of introducing firms is not envisaged by the decree of the CPSU Central Committee and the USSR Council of Ministers "On Measures on the Acceleration of Scientific and Technical Progress in the National Economy." This idea, in our opinion, is to a certain degree an admission of the inability to turn the assimilation of innovations into a natural process, which should be understood as the active participation in it of both sides: science and production. The proposed formation of several hundred new firms (and it is impossible to do with a smaller number on the scale of the national economy) will take place under the conditions of the

aggravated demographic situation. Consequently, a large contingent of skilled specialists will be diverted from the sphere of the development of new equipment.

In our opinion, it is economically more advisable to channel the large investments, which are connected with the organization of additional administrative structures, into the strengthening of the experimental and pilot bases of scientific production associations, scientific research institutes and design bureaus. It is well known that today due to their inefficiency more than half of the innovations being developed are still not being brought up to series production. The expenditures on the strengthening of the pilot base will be recovered in a short time. Experience has confirmed that the organization at scientific production associations and at large scientific research institutes and design bureaus of specialized divisions of introduction, in which the developers of new equipment play a leading role, completely justifies itself.

The plant sector of science: design and technological divisions, pilot sections, plant laboratories and other subdivisions, needs serious strengthening. They know well the conditions of the enterprises, especially their technological possibilities and reserves. Precisely they are to erect bridges in the opposite direction for the rapid passage of new equipment into the sectors of the national economy.

If we look carefully, today the process of introduction is occurring according to the classical scheme: organizations of different departments follow their own path, and only at its end do they meet at the highest level of management--the USSR State Committee for Science and Technology or the State Planning Committee. As a result many intersectorial problems and sharp conflicts, which accompany them, arise. In our opinion, this meeting would be effective not "at the top," which frequently involves arbitration or punitive sanctions, but "among the masses," at the level of scientific production associations, scientific research institutes and enterprises.

There is another problem. Today the areas of the use of advanced processing methods are broadening rapidly. As a rule, they are of an intersectorial nature. Their introduction on the basis of an internal "natural economy" leads to appreciable economic losses: design operations are duplicated, production capacities are split up, the time of the production of nonstandard equipment is dragged out. As a result the level of technological feasibility of an object declines sharply, the time of its assimilation increases, the economic efficiency of the innovation turns out to be less than the standard efficiency.

We see a solution in the overcoming of the stereotype, which has been forming for years and at the basis of which the transfer from sector to sector only of complete sets of technical specifications for an innovation has been placed. A well-compensated mechanism, which stimulates the transfer or, more precisely, the sale of all the accumulated technological know-how from one sector to another, is required.

But, perhaps, a well-founded fee should be introduced for advanced know-how as the result of the accumulated scientific and technical potential, for knowledge of "what to do" and "how to introduce," for participation in the process of introduction, which is being carried out by skilled personnel of the transferring sector, in short, for the total amount of the services which promote the rapid assimilation of an innovation? The fee would also include incentive markups for the achievement of high indicators. The mutual economic interest of the sides, which are taking part in introduction, would appear more here.

One of the important conditions of interest is the elimination of the existing practice of overstating the calculations of the economic impact of an innovation. The fact that the crucial stage of the comparison of new equipment with the best world analogues, just as the calculations of the economic impact, remains the monopoly of the developing organizations, is now its culture medium. Here, figuratively speaking, the projectiles of the economic services of the developers easily pierce the armor which is being set up by the economic services of the clients.

The content and forms of the introduction of new equipment are changing, they are dynamic and should reflect the demands of the national economy and the internal logic of scientific and technical progress. Not only economists and administrators, but also lawyers have to work in earnest. The prevailing enforceable enactments, which regulate the process of introduction, should become a unified and completely realized system, in which a large number of organizations of different levels and departmental subordination are involved.

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CSO: 1814/28

GENERAL

ACHIEVEMENTS, PROBLEMS OF TECHNICAL DEVELOPMENT IN UZBEK SSR

Tashkent PRAVDA VOSTOKA in Russian 20 Oct 84 p 1

[Article: "On the Shoulders of Machines"]

[Text] The Tashkent metro builders were the first in the country to assimilate the new KMO 2X5 tunnel shield, having achieved a record output which is twofold greater than the ordinary output. For work in combination with the shield a mechanized water-proofing device was invented. The impact is a fourfold increase of labor productivity.

Engineering thought and economic research, a creative attitude toward work and reliance on what is new and advanced are yielding an appreciable gain in time, assets and resources and are enabling the metro builders to constantly achieve high production indicators. The collective of the Tashmetrostroy Trust for 14 quarters in a row has taken first place in the competition of related subdivisions of the country.

The decisions of the 26th CPSU Congress and the subsequent party Central Committee plenums aim at using to the maximum extent all the available means for the improvement of economic activity, the acceleration of scientific and technical progress, the increase of labor productivity in all sectors of the national economy, the boosting of the production and the increase of the quality of products.

In the republic there are many collectives, which are working smoothly, regularly fulfill not only the plan, but also the socialist obligations and deliver on time high quality products. Their achievements show what enormous reserves exist in the national economy. And these achievements are inseparably connected with the large amount of organizing and political work of party organizations.

At the same time, as was noted at the 16th Plenum of the Uzbek CP Central Committee, in the republic the available large scientific and technical potential, abundant raw material and manpower resources and favorable natural and climatic conditions for the rapid development of productive forces are being used far from completely. In a number of sectors the output-capital ratio, the profitability and labor productivity have declined, the product quality is low. The measures on scientific and technical progress are

systematically not being fulfilled by many ministries and departments. Thus, in the republic Ministry of Light Industry the output-capital ratio declined by 12 percent, although the fixed capital since the beginning of the 11th Five-Year Plan has increased by 1.8-fold. At every other of the 44 enterprises and production facilities, which have been put into operation during this time, the capacities are being assimilated with a significant delay. At a number of enterprises of the system a large portion of the equipment is obsolete and worn out, many problems of material and technical supply are not being solved. Tens of machine tools are idle due to the lack of minor parts. Things are extremely unfavorable at the weaving and spinning factories of Karakalpakia, where the production capacities are being used at the level of only 33-47 percent. The cases of the decrease of labor productivity and product quality are also alarming. Nearly one enterprise in three is not fulfilling the plan and obligations on deliveries.

Practical experience shows that disruptions of the state assignments and socialist obligations occur most often wherever they do not devote attention to the questions of the renovation and retooling of production, the mechanization and automation of labor-consuming processes.

Party and trade union organizations and economic managers should focus the closest attention on these problems. The most important reserve of the increase of labor productivity lies precisely here. Precisely this is the decisive condition of the fulfillment of the plans of the 11th Five-Year Plan. The effectiveness of these steps is especially obvious, if you turn to the experience of the collectives, which deal daily and persistently with the questions of mechanization and automation. At the Uzbekkhlopkomash Production Association the level of the use of standard technological processes, standard readjustable and standard-unit equipment and readjustable accessories exceeded the plan indicators. Here 20 NC machine tools have been introduced, 8 automatic and 4 gang flow lines are in operation.

In the shops of the main works of the Tashkentskiy traktornyy zavod Production Association 43 units of equipment were modernized, 25 advanced stamps were introduced, a mechanized flow line for the machining of the transmission housing and a section of NC machine tools, which is equipped with industrial robots, are in operation. Tools made from new hard alloys and superhard materials, the method of powder metallurgy and other innovations are finding more and more extensive use. And here are the encouraging figures: by means of decreasing the product cost 1,872,000 rubles were saved, labor productivity increased by 3.5 percent, the degree of mechanization at the main works was increased to 80 percent, the proportion of products of the highest quality category increased. Owing to the high standards of the organization of production, as well as the concern about the social development of the collective the Tashkent tractor builders were able to increase the machine shift coefficient to 1.64 and to decrease the turnover of personnel by nearly one-half as compared with 1980.

However, in many sectors of industry of the republic the output-capital ratio is low, especially in the production of steel, zinc, mineral fertilizers and cement. In machine building the machine shift coefficient does not exceed 1.35. In Fergana Oblast, for example, in 8 years the fixed production capital

increased by 76 percent, while the production volume during this time increased by only 30.6 percent. One of the reasons for such a situation is the slow assimilation and use of production capacities, especially at enterprises of light, local and the food industries. The achievements of scientific and technical progress are being introduced poorly. At present in Fergana Oblast the proportion of manual labor comes to 30 percent, while at enterprises of the food industry it comes to 45 percent and of local industry--about 37 percent. This is affecting labor productivity. There are enterprises, for example, the Azot Association, the chemical fiber plant, at which the increase of wages leads the growth of labor productivity.

The output-capital ratio especially decreased at the enterprises of the Ministry of the Construction Materials Industry and the food industry in Khorezm Oblast. Up to now in industry about 40 percent of the workers perform operations by hand in basic production. But uninstalled equipment worth more than 2.5 million rubles has piled up. The production capacities are also being used poorly at the enterprises of Samarkand Oblast. The machine shift coefficient is intolerably low here.

At the 16th Plenum of the Uzbek CP Central Committee it was stressed that the acceleration of the pace of complete mechanization and automation is the most important task of party organizations and economic managers. It is necessary to equip plants and factories with new highly productive machine tools and machines, to introduce NC machine tools, robots and manipulators, to cultivate among the workers of enterprises an interest in new equipment and the aspiration to understand it and to achieve its high efficiency.

The rayon party committees and party organizations and the local soviets should be more concerned with the questions of the mechanization of operations and the decrease of manual labor in all sectors of the national economy. It is necessary to tighten up the monitoring of the fulfillment of the plans of organizational and technical measures, which are aimed at the improvement of working conditions, and to hold strictly accountable the economic managers, who do not ensure the assimilation of the assets, which have been allocated for renovation and retooling, and do not take steps to facilitate the labor of workers.

It is envisaged by the socialist obligations of the workers of Uzbekistan in 1984 to completely mechanize and automate 100 sections, 92 shops and works, to put into operation 175 mechanized flow and automatic lines and more than 60 manipulators and robots and to set up 21 automated control systems. All this will make it possible to free conditionally 29,000 people.

The tasks are difficult. But experience shows that the labor collectives under the guidance of the party organizations can successfully cope with them.

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CSO: 1814/28

GENERAL

SUPPLY OF SCIENTIFIC INSTRUMENTS

Leningrad LENINGRADSKAYA PRAVDA in Russian 4 Nov 84 p 2

[Statement by M. L. Aleksandrov, general director of a scientific and technical association of the USSR Academy of Sciences, recorded by Zh. Manilova: "The Tools of Research"]

[Text] What are the working tools of science today? The time, when "improvised means" and ingenuity alone sufficed a person for knowledge of the surrounding world, is long past. Even Newton, who ostensibly "came across" the idea of the law of universal gravity by means of an ordinary apple, had at his disposal quite complicated and accurate, for those times, of course, instruments.

But, of course, discoveries "at the tip of a pen" are also possible today, and still there are fewer and fewer of them. Today's tools of science are an entire developed enormous sector, on the successes of which the speed of our movement along the path of scientific and technical progress depends. Powerful computers and space radio telescopes, orbital stations and synchrophasotrons, the construction of which only the technically most developed states can venture--all this serves mankind for the improvement of our ideas about the surrounding world.

We offer the reader the statement of M. L. Aleksandrov, general director of a scientific and technical association of the USSR Academy of Sciences. Set up several years ago on the basis of the Special Design Bureau of Analytical Machine Building, it is today among the most powerful organizations in the system of the academy and is responsible for the supply of basic science with the necessary instruments.

How is this unit accomplishing the tasks set for it, what contribution is it making to the implementation of the Intensification-90 Program? Today's discussion is about this.

Modern science does not live on ideas alone, even the most brilliant ones. Complex instruments and modern equipment have come to the aid of scientists. It can be safely claimed: if such equipment were not in the hands of man, there would not be today such sciences as thermonuclear physics and electronics, space physics and biotechnology, the development of traditional sciences--geology, chemistry, biology--would also be impossible. But it is a matter not only of this. Since science in the age of the scientific and technical revolution is a productive force of society, which influences most directly the development of the sectors of the national economy, the tool supply of scientific research is acquiring exceptionally great economic importance. Especially now, in the process of the implementation of the Intensification-90 Program, which has received the support and endorsement of the CPSU Central Committee.

It is well known that Leningrad has an enormous scientific and technical potential. This is hundreds of scientific research and planning institutes, scientific production associations and design bureaus. For many of them, but first of all for academic institutes, the work of which is connected with the solution of the basic problems of science, we are developing both single-design and series-produced instruments. For example, for the Physical Technical Institute and the Institute of Nuclear Physics, for the State Optical Institute and Leningrad University, the Institute of High Molecular Compounds and Leningrad Polytechnical Institute. Of course, this is far from a complete list.

Instruments of nuclear magnetic resonance, mass spectrometers, optical spectral instruments and chromatographs also serve as reliable tools of knowledge for many other scientific organizations of the country and are in demand among highly recognized foreign firms, which, I believe, serves as evidence of their great competitive ability. As a rule, these are instruments for the analysis of the composition and structure and the identification of a substance, that is, for a very delicate and complex analysis, which makes it possible to detect one extraneous atom among hundreds of millions of others. Strictly speaking, now there are not even instruments in the customary understanding of the work, but entire systems which operate together with computers.

But at times this "duo" is also insufficient. Even a computer is not enough, for example, for a researcher while working at a mass spectrometer (an instrument for the analysis of the structure of a substance) to obtain and record the information in full. The time of the "dumping" of information in the process of research is so insignificant, while its volume is so great, that the possibilities of modern computers are often not enough. Additional microprocessor devices and the appropriate software are necessary. That is why in recent years we have been dealing with the development of instruments on the basis of microprocessor equipment and special programs, as well as with the development of modules on the basis of the KAMAK system, which has been adopted as an international standard for the base system of automation. (By the combination of various modules it makes it possible to "link" with the computer not only an automatic line, but also NC machine tools, a nuclear reactor and so on.)

In short, in developing such complex instruments or, rather, entire systems of them, we are, in essence, engaging in the automation of scientific research, without which, I am convinced, the full-fledged contribution of science to the fulfillment of the Intensification-90 Program is impossible.

Life and its requirements are now such that you will not go far along the old paths. The accomplishment of the new tasks on providing science with highly complicated instruments to an enormous extent depends on how successfully we use our own reserves. The Scientific Research Institute of Analytical Instrument Making, design bureaus and a large number of plants in Leningrad, Moscow and Minsk belong to the association. This is a large industry, but it is a matter not even of its scale. Today a different level than before of the organization of the entire "science--production" cycle is necessary, a more intensive pace of the development and creation of new equipment is needed.

In discussing now our plans, which concern the Intensification-90 Program, the party committee and management of the association not by chance are putting in first place the problems of the training of personnel. Work under the new conditions requires of people not only organizational, but also psychological change. The specialist of any type and any rank--from the scientist to the worker--whether he likes or not has to give up now the ideas, which have been customary up to now, about the rhythm of work, which is becoming many times more intense, and about the time of the fulfillment of one theme or another. Every scientific idea, which merits attention, should quickly pass through all the subsequent stages to the finished instrument, otherwise an item can become obsolete, having barely come into being, and all the done work will lose meaning. I believe that basically our collective is ready for such change. Incidentally, at present we are drafting proposals on the changeover of designers and process engineers to the new system of the remuneration of labor. We want, in short, also to conduct within the academy's walls the economic experiment which has shown itself to advantage at Leningrad enterprises.

Our future and present concerns require of us not only the revision of the methods of work with people and the solution of complex personnel problems, but also the reform of the structure of the scientific and technical association. Thus, for speeding up the work on the experimental plant now being built in Lomonosov (about it a little later) we are establishing a special division, which will deal with the complex task "science--production." In connection with the Intensification-90 Program the reform will also concern many other subdivisions and services. But primarily the services for the development of automation systems.

As to the new plant in Lomonosov, for us its start-up is one of the most important problems, after the solution of which we will be able to place the intensification program on a firm basis. The point is that this quite large enterprise was designed long ago. NC machine tools and versatile automated production systems at that time were exotic things, but now without the most advanced machinery and the latest automation equipment we would simply not be able to work and to produce complicated instruments. Here it is necessary to update the design on the go: without decreasing the pace of construction, to revise all the design documents, so that production automation systems would

take their place at the new plant complex. This is extremely necessary, because precisely the plant in Lomonosov will become for us a kind of testing ground, a model of a modern enterprise, the experience of which we will also extend to other plants of the association.

But while construction is under way and all kinds of problems are being settled, it is just the time to think about who will work at the new plant and will have that degree of competence, which is necessary in work at an automated works. We have the following plans in this regard. In Lomonosov there is Specialized City Vocational and Technical School No 20. The Main Administration of Vocational and Technical Education met us halfway, and soon we will organize by joint efforts the training of specialists in versatile automated production systems. It will be necessary, of course, to revise radically the instruction program and to furnish the school with the necessary equipment. We intend, in particular, to organize there a special section for the adjustment of KAMAK modules and so on. Scientists of the association will concern themselves with the teaching of such important subjects as physics and mathematics, radio electronics and automation.

Personnel, organizational and technical problems are for us units of the unified comprehensive program on the shortening of the "science--production" cycle. A quite specific task is being set today for developers of instruments for research: that science would actually become a catalyst of scientific and technical progress, it should itself be developed most intensively. But this is quite inconceivable without tools which are modern in the full sense of the word.

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CSO: 1814/28

GENERAL

CPSU SCIENTIFIC, TECHNICAL POLICY

Moscow KOMMUNIST VOORUZHENNYKH SIL in Russian No 19, Oct 84 pp 9-15

[Article by Doctor of Philosophical Sciences and Professor Colonel V. Bondarenko: "The Unified Scientific and Technical Policy of the CPSU"]

[Text] Our society is at such a historical stage of development, when profound qualitative changes in the productive forces and the improvement of production relations, which corresponds to this, have become necessary. The Leninist party is showing the main means of such changes: the changeover from extensive to intensive methods of national economic development, the direct combination of the advantages of the socialist system with the achievements of the scientific and technical revolution. "Intensification, the rapid introduction in production of the achievements of science and technology, the implementation of major comprehensive programs," Comrade K. U. Chernenko stressed at the Extraordinary February (1984) Party Central Committee Plenum, "all this in the end should raise to a qualitatively new level the productive forces of our society."

The successful accomplishment of the difficult tasks of improving mature socialism presumes the further acceleration of scientific and technical progress. The elaboration and implementation by the party of a unified scientific and technical policy (YeNTP) are one of the most important steps in this direction.

The idea of the state planning of scientific and technical operations originated in our country during the building of socialism. In the short article of V. I. Lenin "An Outline of a Plan of Scientific and Technical Operations," which was written in April 1918, the basic aims of the policy of the Soviet state in the area of science and technology were presented in a concise form. They envisaged "the systematic study and investigation of the natural productive forces of Russia" and the taking of steps for the purpose of "the quickest possible drawing up of a plan of the reorganization of industry and economic development" (see "Poln. sobr. soch." [Complete Works], Vol 36, p 228).

A special plan of "operations on the restoration of the entire national economy and its bringing to modern technology"--the plan of the State Commission for the Electrification of Russia--was also drawn up under the

guidance of the party. This plan was the first plan of the development of the national economy on the basis of electrification and the extensive introduction of advanced technology. During subsequent periods of the development of the USSR economy the party also attached great importance to questions of scientific and technical policy.

A qualitatively new stage of the implementation of the scientific and technical policy of the CPSU and the Soviet state began during the postwar years in connection with the development in our country of the scientific and technical revolution. On the one hand, the achievements of scientific and technical progress made it possible to increase labor productivity significantly by the introduction of the latest equipment and technology and, on the other hand, the latest equipment and technology provided the opportunity to use more thoroughly and completely raw materials, which were becoming more and more costly, as well as to switch to energy-saving technological processes.

The need to switch to the implementation of a unified scientific and technical policy in our country is also dictated by science itself, the level and nature of its development, the ability to generate new ideas and to bring them up to implementation. The stepping up of the process of turning science into a direct productive force and, as applied to other spheres of social life, into an active social force is conducive to this. The 26th CPSU Congress noted that science constitutes the base of the bases of modern scientific and technical progress. Precisely it should become a constant "disturber of the peace," showing in what sections stagnation and a lag have been noticed, where the present level of knowledge makes it possible to advance more rapidly and more successfully. Soviet science is at the front line, it has everything necessary for the scientific and technical support of the increasing socioeconomic needs of our society.

The unified scientific and technical policy is an important sphere of the activity of the CPSU, the Soviet state and labor collectives, which is aimed at the coordination of all the directions of science and technology and the effective use of their achievements for the improvement of mature socialist society and the strengthening of the defensive capability of the country. The decisions of the 24th, 25th and 26th CPSU congresses and a number of subsequent party Central Committee plenums are of fundamental importance in the elaboration and implementation of the unified scientific and technical policy during the period of mature socialism. While using the experience of the past, the CPSU also takes into account the new demands, which are being advanced by the present trends of the development of the productive forces and socialist production relations.

The unified scientific and technical policy includes the following basic components: the goals of the use of the achievements of science and technology, a set of views on the objective possibilities of scientific and technical progress, as well as a set of state measures on the management of the development of science and technology and on the use of their achievements in various spheres of social life. It is a question first of all of the goals, in the name of which and for which specific decisions are made in the area of the development of science. It is clear that such goal are defined

not abstractly, but in strict conformity with the ideals of our social system, on the basis of the quite specific sociopolitical needs of society, which follow from its nature. Whereas the socialist state uses scientific and technical achievements for the accomplishment of the main task--the building of a communist society, a society of social justice, the class of capitalists makes furious efforts to increase its profits. The militarization of all areas of life, which is characteristic of imperialism, appears in the use of the successes of scientific and technical progress not for the good of man, but for the further increase of the arsenals of military equipment, the arms race and the development of new means of waging aggressive wars and wars of conquest.

Scientific knowledge and, on its basis, the development of technology have a quite specific internal logic. In other words, a specific sequence of the broadening of scientific knowledge and of its materialization in technology exists. The establishment in the unified scientific and technical policy of the optimum correlation of the goals of the use and the objective possibilities of science and technology at the given stage is very important on the theoretical and practical level. The dialectics here is quite complex.

The goals of scientific and technical policy should conform to the possibilities of science and technology of the country at the specific historical stage of its development. At the same time the specification of these goals and their practical realization lead to the significant stepping up of scientific research in a prescribed direction. Such activity and the use of new means and methods of research make it possible to reveal significantly more completely and thoroughly the possibilities of scientific knowledge and to see more clearly the trends which were previously concealed.

In the dialectical combination of the goals and the internal possibilities of the development of science its theoretical cognitive and social aspects find their expression. Science appears as a constantly developing process of perceiving the objective laws of nature and social reality, the goal of which in the end is the meeting of the vital needs of society.

Under the conditions of the socialist system and the public ownership of the means of production, given the collectivistic nature of production relations and centralized planning the development of science and technology can be carried out effectively only as a unified statewide policy. It is realized on the basis of a common conception and unified directions at all levels of the economic structure--from the national economy as a whole, the sector and the region to the enterprise, the organization and their subdivisions.

One of the effective means of the unified scientific and technical policy is the state scientific and technical programs, which are formulated and implemented by the USSR State Committee for Science and Technology (GKNT), the USSR State Planning Committee and the USSR Academy of Sciences jointly with ministries and departments. These programs are becoming an effective tool of the solution of intersectorial scientific and technical problems. The USSR State Committee for Science and Technology together with the USSR Academy of Sciences, the USSR State Planning Committee and, for problems of construction, the USSR State Committee for Construction Affairs formulated for the 11th

Five-Year Plan and up to 1990 170 most important state scientific and technical programs. The choice of their goals was made on the basis of the decisions of the 26th CPSU Congress and a number of subsequent party Central Committee plenums with allowance made for the current and long-range needs of the national economy, as well as the trends of the development of science and technology, which were specified by the Comprehensive Program of Scientific and Technical Progress to 2000.

A wide range of research and development in the area of the development of the fuel and power and the agroindustrial complexes, machine building, the chemical industry, metallurgy, transportation, health care and consumer goods production is encompassed by the state scientific and technical programs. They are also ensuring the practical implementation of the most effective scientific and technical achievements already during the current five-year plan, including the series production of new products. More than 120 programs are aimed at the solution of most important scientific and technical problems, the development and bringing up to introduction in production of new equipment, technological processes and materials. Their fulfillment will make it possible to obtain during the current five-year plan about 16 billion rubles and will provide a saving of 4 million tons of ferrous metals, more than 50 million tons of conventional fuel and 14 billion kWh of electric power. The implementation of the measures, which have been outlined by the programs, will save the labor of about 3 million people.

The party regards the radical improvement of the work on the acceleration of scientific and technical progress as a most important task of party, soviet, economic, trade union and Komsomol organizations. The decree of the CPSU Central Committee and the USSR Council of Ministers "On Measures on the Acceleration of Scientific and Technical Progress in the National Economy," in which it is stated frankly that the successes in all directions of scientific and technical progress will be all the more significant, the more persistently scientific collectives and their party organizations strive for the further concentration of the potential of scientific research, design and technological organizations on the accomplishment of the tasks which ensure the meeting of both the current and the long-range needs of the country, increase the effectiveness of research work and actively promote the large-scale introduction of the achievements of science, aims at the accomplishment of this task.

Definite experience of work in this direction has already been gained in our country. At the 26th CPSU Congress it was noted, in particular, that industry of the city of Novosibirsk has given a start in life to many developments of scientists of the Siberian Department of the USSR Academy of Sciences. ASU's (automated control systems) and ASUTP's (automated systems for the control of technological processes), explosion welding and forming, the production of complicated shaped items from sheet metal by pressing under the conditions of creep, the hardening of thin-walled items made from aluminum alloys, the development of vibration-proof tools and machines and much more can serve as an example.

The cooperation of the Siberian Department of the USSR Academy of Sciences with large plants, sectorial scientific research institutes and design bureaus

served as the basis for the establishment of extensive ties with various sectors of the national economy. At present the scientists of Novosibirsk have bilateral long-term agreements with 22 union and republic ministries and departments. The basic goal of such cooperation is the joint solution of urgent scientific and technical problems and the speeding up of the use of the results of research for increasing the quality of the output being produced by means of new processing methods, instruments and materials. The collectives of the institutes and enterprises, which have been united by goal programs, have learned to work in harmony, and this harmony is ensuring the fulfillment of the adopted programs and their attachment to the national economic plan.

The new stage in the implementation of the scientific and technical policy of the CPSU and the Soviet state is characterized by the significant increase of the demandingness and the responsibility for the fulfillment of the plans and assignments on the development of science and technology. Henceforth their fulfillment is being included among the most important indicators, in accordance with which the evaluation of the results of the economic activity of the enterprise is made and the results of socialist competition are summarized.

The need for the concentration of scientific research, design and technological forces at large associations and enterprises is also stressed in the decree of the CPSU Central Committee and the USSR Council of Ministers, which was referred to above. Scientific and technical associations are undergoing further development. With allowance made for the need for the prompt solution of several national economic problems it is deemed expedient to expand the practice of the organization at associations and enterprises of temporary scientific production subdivisions. The establishment of similar collectives of an intersectorial nature is envisaged. The decree broadens the areas of the use of economic levers, which, on the one hand, will stimulate by means of increments and bonuses those who have made gains in scientific and technical progress and, on the other hand, will exert "pressure by the ruble" on those who do not succeed in its rapid development. The position of general designer for basic types and systems of machines, equipment and instruments is being introduced at some large associations and enterprises. This measure will make it possible to concentrate the creative efforts of scientific, technical and design thought on the solution of the most important, key scientific and technical problems.

The development in our country of industrial robots can serve as an example of the use of comprehensive scientific and technical planning, which is aimed at the obtaining of an end result. A unified plan of robot building was drawn up for the first time in the USSR State Committee for Science and Technology in 1972. The council "Robots and Robotic Systems" is operating in the USSR Academy of Sciences. The first 30 series-produced types of industrial robots, including general-purpose robots, appeared during the 9th Five-Year Plan. During 1976-1980 100 new types of such units were produced, while in 1983 alone 11,000 were produced. Our Tsiklon 3B, Universal 5, Sprut and other robots are not inferior to the best foreign models.

At the Kovrov Machinery Plant, for example, 60 robots are being used. As a result labor productivity in the automated sections has increased by threefold

(in several by five- to sixfold), the labor intensiveness has been decreased by 40-50 percent, about 100 people have been freed, the annual economic impact comes to 300,000 rubles. Let us note that the fulfillment of the program of robot building, which was outlined for the current five-year plan, in the country will make it possible to free about 100,000 workers and to save annually more than 300 million rubles.

However, the demand for robotics substantially exceeds the supply. In 1985 it is anticipated that the need for robots will exceed 100,000, while the stock will come to only 40,000 units. The mass production of the second generation of robots, which starting in 1985 will begin to play a leading role, is being checked by the relatively small production of sensors, signal converters and especially microprocessors, without which it is impossible to produce modern robots.

This circumstance underscores the importance of systemicity in the planning of scientific and technical operations and the need for the implementation of a unified scientific and technical policy, which would make it possible to coordinate completely the various directions of the development of science, technology and production.

The party is attaching the most serious importance to the development of machines, devices and processing methods, which conform to the tasks of both the present and the future. The basic demands, which are being made on processing methods, are their continuity, flexibility, the automation of processes in accordance with prescribed conditions, the ability to provide a saving of materials. Versatile automated production systems (GAP's) are called upon to increase the proportion of small-series and custom production and to ensure the quick changeover to the production of a new part. This will make it possible to a certain extent to solve the urgent problem of the shortage of workers. Specialists have calculated that at enterprises of the future, which operate in accordance with the concept of versatile automated production systems, the number of workers might be one one-hundredth as many as at existing enterprises.

The USSR Energy Program, which was adopted more than a year ago and is intended for the long-term future, is called upon to have an enormous influence on scientific and technical progress in all sectors. The party is attaching great importance to the scientific and technical problems which are connected with the implementation of the USSR Food Program for the Period to 1990. These are the strengthening of the material and technical base of agriculture and the other sectors of the agroindustrial complex, the increase of the productivity of plant growing and animal husbandry and the development of highly efficient systems and sets of machines, which ensure the all-round mechanization of basic and auxiliary operations.

In its decisions the party directs the attention of scientific personnel and all workers of production to a high level of organization in the implementation of scientific and technical programs. The CPSU is proceeding from the fact that today not individual achievements in some area or other of science and technology, but a high scientific and technical level of all production is important.

The party is displaying constant concern about the strengthening of the scientific potential of the country. Thousands of scientific institutions, approximately 250 scientific production associations, 900 higher educational institutions and about 40,000 planning and design organizations and subdivisions are now engaged in research and development. More than 50,000 laboratories at industrial enterprises are also performing separate research and development.

Our country in a relatively short historical period has trained the largest detachment of scientists in the world. Now their number exceeds 1.4 million. Together with attendants about 5 million people are now taking part in the conducting of scientific research. The indicators of the vocational training of our scientific personnel are also quite high. Among Soviet scientists there are about 440,000 candidates of sciences, more than 40,000 doctors of sciences and about 30,000 academicians, corresponding members and professors. The reserve of scientific personnel is very impressive. In the country more than 18 million people have a complete higher education. In 1983 1.1 million people were admitted to higher educational institutions, in all 5.3 million students are studying at them.

The financing of scientific research is the most important means of managing the scientific resources of the country. The expenditures on science came in 1983 to 25.6 billion rubles, while in 1970 they came to 11.7 billion rubles, and in 1950 to 1 billion rubles. Here the increase of the financial resources of science expresses not only the rate of development, but also the realization by society of its place and role in the accomplishment of immediate and long-range national economic tasks. During the 9th Five-Year Plan (1971-1975) in our country the expenditures on science from the state budget and other sources of financing came to 77 billion rubles, during the 10th Five-Year Plan (1976-1980)--97.9 billion rubles, in 3 years of the 11th Five-Year Plan 76.1 billion rubles were spent. In 1984 26.6 billion rubles, or 3.7 percent more than in 1983, have been allocated for scientific research. "In our country," Comrade N. A. Tikhonov said at a meeting with voters, "the labor of the scientist is surrounded with universal respect.... But, as they say, much is asked from him, to whom much has been given. And we have the right to expect of scientists even more fruitful work, creative research, the increase of their contribution not only to the development of new equipment and technology, but also to the matter of introducing scientific and technical achievements in practice."

Here the concentration of the efforts of scientists, designers and process engineers on the practical solution of the fundamental problems of the intensification of the national economy and the elimination of so-called bottlenecks is a task of prime importance. The most urgent question is the low efficiency of the work of several scientific research institutions. This is explained, in particular, by the fact that, starting with the late 1960's, practically all ministries and departments strove to have their own scientific research institutions. In all 1,100 of them were established. In itself such a phenomenon reflected a progressive trend. However, the excessive haste had the result that scientific research institutions were often established without the necessary personnel, scientific and technical and first of all

experimental base. All this in the end decreased the efficiency of work. And not by chance have 145 institutes, which were not providing appreciable results, been closed in recent times on the initiative of the USSR State Committee for Science and Technology, which has made it possible to use scientific personnel more efficiently.

The main goal of scientific and technical progress in our country is the creation of the necessary prerequisites for the improvement of mature socialism. However, the harsh reality of our times is forcing the Soviet Union and its allies to devote daily attention also to the strengthening of the defensive capability of the socialist community.

The historical necessity of defending the gains of socialism is turning the defensive needs of society into a factor which is taken into account without fail in the unified scientific and technical policy of the country. The USSR, the fraternal socialist countries and all the progressive forces of the planet are struggling resolutely for the preservation of peace and the assurance of international security. First of all the great vigilance of the Soviet people and the battle readiness of the USSR Armed Forces and the armies of the Warsaw Pact countries, which is growing stronger from day to day, are being opposed to the aggressive intrigues of imperialism. Today aircraft and tanks, missile complexes and ships, modern artillery and small arms, which meet the most advanced requirements, are in their armament. Soviet scientists, designers and workers developed them for the reliable defense of the gains of socialism.

In a speech at the All-Army Conference of Secretaries of Komsomol Organizations Comrade K. U. Chernenko especially stressed the importance of the role which the containing power of our defensive potential is playing under present international conditions. It serves as a guarantee of the reliable defense of the peaceful creative labor of the Soviet people and the peoples of the countries of the socialist community and universal peace on earth.

The correlation between the overall scientific and technical possibilities of the country and that portion of them, which under specific conditions is channeled into the solution of military problems, is not stable. Subject to the forming international situation within the unified scientific and technical policy the possibility exists to focus scientific research on the accomplishment of primarily national economic or defensive tasks. The implementation of such measures is far from a simple matter, but events on the world arena are making it necessary.

The unified scientific and technical policy makes it possible to combine optimally military and nonmilitary scientific research. And this has a positive effect on the process of using the results of basic research both in the interests of strengthening the defensive capability of the country and in the development of the sectors of the national economy. The broadening of such an interconnection makes it possible both to solve efficiently the scientific and technical problems of strengthening the combat potential of the Armed Forces and to broaden the opportunities for using the results of military technical research for the improvement of production.

The unified scientific and technical policy of our party is a historically dictated, important means of the intensification of social production, the improvement of mature socialist society and the strengthening of its defensive capability. The effective development of scientific and technical research and the efficient use of its results in the economic, social and military areas are in full accord with the interests of the Soviet people and with the interests of our friends and allies.

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